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Mobile Radio Technology™

The journal of mobile communications technology

Personal communicator, p. 10

Servicing pagers

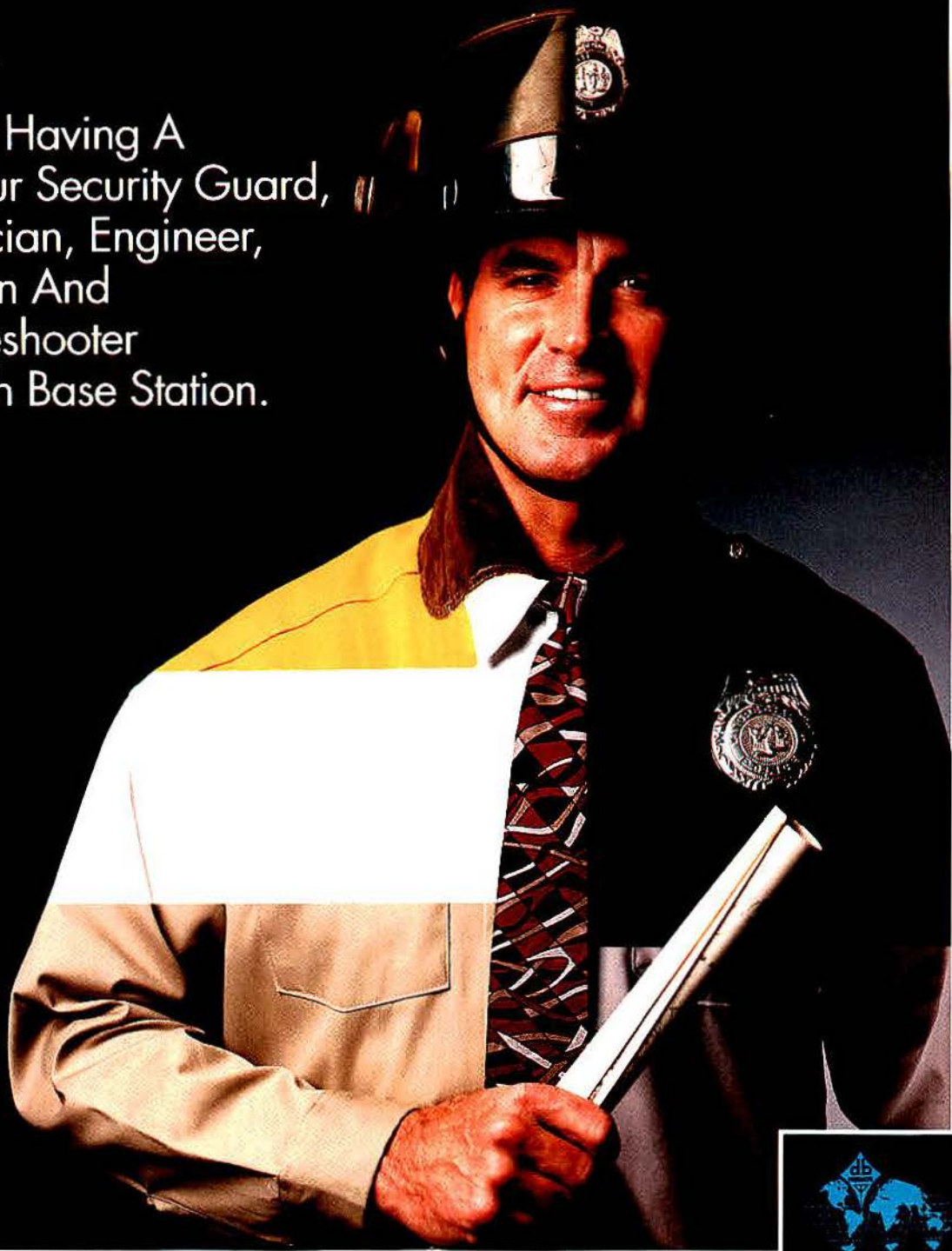
Quality management

Field intensity vs. signal level

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features

10 Simon boasts multiple functions for mobile communications

Rich Guidotti

Hand-held cellular telephone, wireless facsimile, pager, electronic mail, calendar, appointment scheduler, address book, calculator and pen-based note-and-sketch pad functions are integrated into one unit.

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MRT staff

More than 300 mobile communications equipment manufacturers, distributors and service providers will convene at the Las Vegas Convention Center as they gear up for 1994. Use our pull-out map and exhibitor list to guide you through the exhibit hall.

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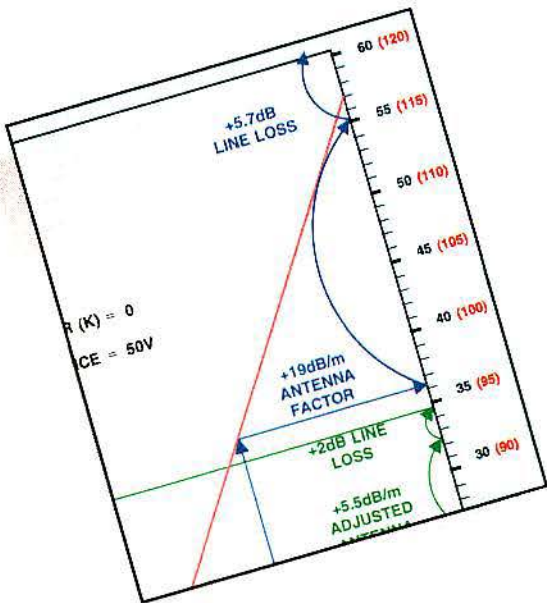
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On the cover: Designed by IBM and marketed by BellSouth Cellular, the Simon personal communicator's liquid crystal display (LCD) is a touch-screen graphical user interface (GUI). The unit may be used to make cellular phone calls and send and receive facsimile messages. See Rich Guidotti's article on page 10. *Photo courtesy of BellSouth Cellular, Atlanta.*

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Selectone

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Telocator becomes Personal Communications Industry Association



It's official: Telocator has changed its name to Personal Communications Industry Association (PCIA).

Founded in 1949 as the National Association of Radio Systems (NARS), the association was renamed Telocator Network of America in 1977. Perhaps the thinking at the time was that pagers deserved a better nickname than "beepers," and "telocator" (short for "telecommunications locator") would be classier. It never caught on.

Later, the association's name was shortened to "Telocator"—or maybe it was lengthened, because the association always included the phrase "Mobile Communications Industry Association" to describe the association's mission. As that mission changed, so did the descriptive phrase, to "Personal Communications Industry Association."

This time, the descriptive phrase survives as the association's name, and the name Telocator has been retired.

So has the name of the association's trade show, "Mobile Communications Marketplace." Its name has been changed to "Personal Communications Showcase." That's a good choice, isn't it? The name's acronym, PCS, is commonly interpreted as "personal communications services," and if the trade show name is interpreted that way, well, it may even be helpful.

On the other hand, will PCIA be misinterpreted to mean "Personal Computer Industry Association?" Will it be confused for PCMCIA? (That stands for Personal Computer Memory Card International Association — what a mouthful.) Maybe, but it probably won't matter too much. After all, to the rest of the electronics world,

CAD means "computer-aided design." In our little corner, it means "computer-aided dispatch." The difference hasn't seemed to matter.

PCIA's members continue to change, and in fact they bear little resemblance to the members of the old NARS. PCIA currently represents 450 companies, including PCS experimental licensees and entrepreneurs, paging, cellular, cable television, manufacturing, computer, mobile data, specialized mobile radio (SMR) and interexchange sectors of the industry. Many of them didn't exist during the association's early history.

We wish our friends at PCIA and their members continued growth and success with the new name. We don't think the new name business is over, though. After all, they haven't fit the word "wireless" into their name yet.

* * *

Trouble in 9-1-1 land

Speaking of PCS, public safety agencies are worried that they may lose the capability they now have to identify callers and locations electronically and automatically when people dial 9-1-1 for emergency service.

The latest 9-1-1 equipment adapts telephone company billing information gathered from every telephone call to display the name of the telephone subscriber and the telephone's location to the emergency

service dispatcher answering the call. The equipment routes the call to the appropriate "public safety answering point" (PSAP) nearest to the telephone where the call originates.

Landline telephones (which some consider to be part of PCS — see the box on this page) are in fixed locations, so automatic caller and location identification is possible. Wireless telephones, such as specialized mobile radio (SMR) phones, personal telecommunications service (PTS) phones and cellular phones, have no fixed location.

Emergency dispatchers field thousands of calls from callers using wireless phones. Sometimes, callers are confused about their location or, in some emergencies, cannot speak. Because telephone connections with wireless phones do not carry caller and location identification information, the calls sometimes are routed to the wrong PSAP, and emergency services sometimes are sent to the wrong location or are delayed for lack of any location information.

The answer may be to fit wireless phones with location monitoring circuits that use signals from orbiting satellites or terrestrial base stations to compute their location, feeding that information automatically with each call. The more 9-1-1 calls are placed with SMR, cellular and the future PTS phones, the greater the potential for loss of life unless a provision for automatic location identification is made.

—Don Bishop

Personal communications services

Ask three people to define personal communications services (PCS), and you'll get three different definitions. Here is the way PCIA once defined PCS:

Existing PCS

Landline/Enhanced Landline
Dispatch/Enhanced Dispatch Radio
Radiopaging/Enhanced Radiopaging
SMR/Enhanced SMR
Cellular Phone/Enhanced Cellular Phone
Cordless Telephone

Emerging PCS

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- 2-4—**Cellular Telecommunications Industry Association Winter Meeting and Exposition**, San Diego. Contact: 202-785-0081.
6-9—**Energy Telecommunications and Electrical Association**, Henry B. Gonzales Convention Center, San Antonio. Contact: 214-235-0655.

April

- 13-15—**International Wireless Communications Expo/Spring**, Las Vegas Convention Center, Las Vegas. Contact: 1-800-828-0420.

May

- 2-5—**Supercomm**, sponsored by USTA and TIA, and **International Conference on Communications**, sponsored by IEEE, New Orleans. Contact: USTA, 202-835-3100.
12-14—**Mobile Communications Conference**, sponsored by the National Association of Business and Educational Radio (NABER), Peabody Hotel, Orlando, FL. Contact: Nancy Palleschi, 800-759-0300.
25-27—**RadioComm**, Vancouver Convention Center, Vancouver, British Columbia. Contact: Bill Eggertson, 613-233-4888.

June

- 7-11—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Stockholm, Sweden. Contact: Professor Sven-Olof Ohrvik, technical chairman, 46 8 757 0483; Fax 46 8 34 8441.
18-20—**International Public Safety Exposition and Conference**, sponsored by the International Association for Public Safety, Dallas Convention Center, Dallas. Contact: 203-847-9679.
19-23—**Utilities Telecommunications Council**, Washington Sheraton, Washington, DC. Contact: Christine Benz, 202-872-0030.

July

- 17-20—**Forestry-Conservation Communications Association**, Hershey, PA. Contact: Don Pfohl, 602-644-3166.

August

- 6-11—**International Municipal Signal Association**, Cavanaugh's Inn, Spokane, WA. Contact: Harold Glerum, 800-723-4672.
7-12—**Associated Public-Safety Communications Officers National Conference**, Lawrence Convention Center, Pittsburgh. Contact: 800-824-1850.

September

- 22-24—**Mobile Communications Marketplace**, Washington State Convention Center, Seattle. Contact: 800-326-8638.

October

- 3-5—**WirelessWorld Conference & Exhibition**, sponsored by *Cellular Business* magazine, The Stouffer Orlando Resort, Orlando, FL. Contact: Stephanie Hanaway, 913-967-1856.
15-20—**International Association of Chiefs of Police**, Albuquerque Convention Center, Albuquerque, NM. Contact: 703-243-6500.
19-21—**International Wireless Communications Expo/Fall**, Tampa Convention Center, Tampa, FL. Contact: 303-220-0600.

November

- 18—**Radio Club of America**, Communications Symposium, Annual Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

1995

February

- 1-3—**Cellular Telecommunications Industry Association Winter Meeting and Exposition**, New Orleans. Contact: 202-785-0081.

April

- 3-5—**Energy Telecommunications and Electrical Association**, George R. Brown Convention Center, Houston. Contact: 214-235-0655.



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The Journal of mobile communications technology

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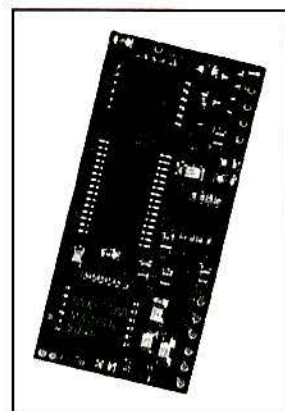
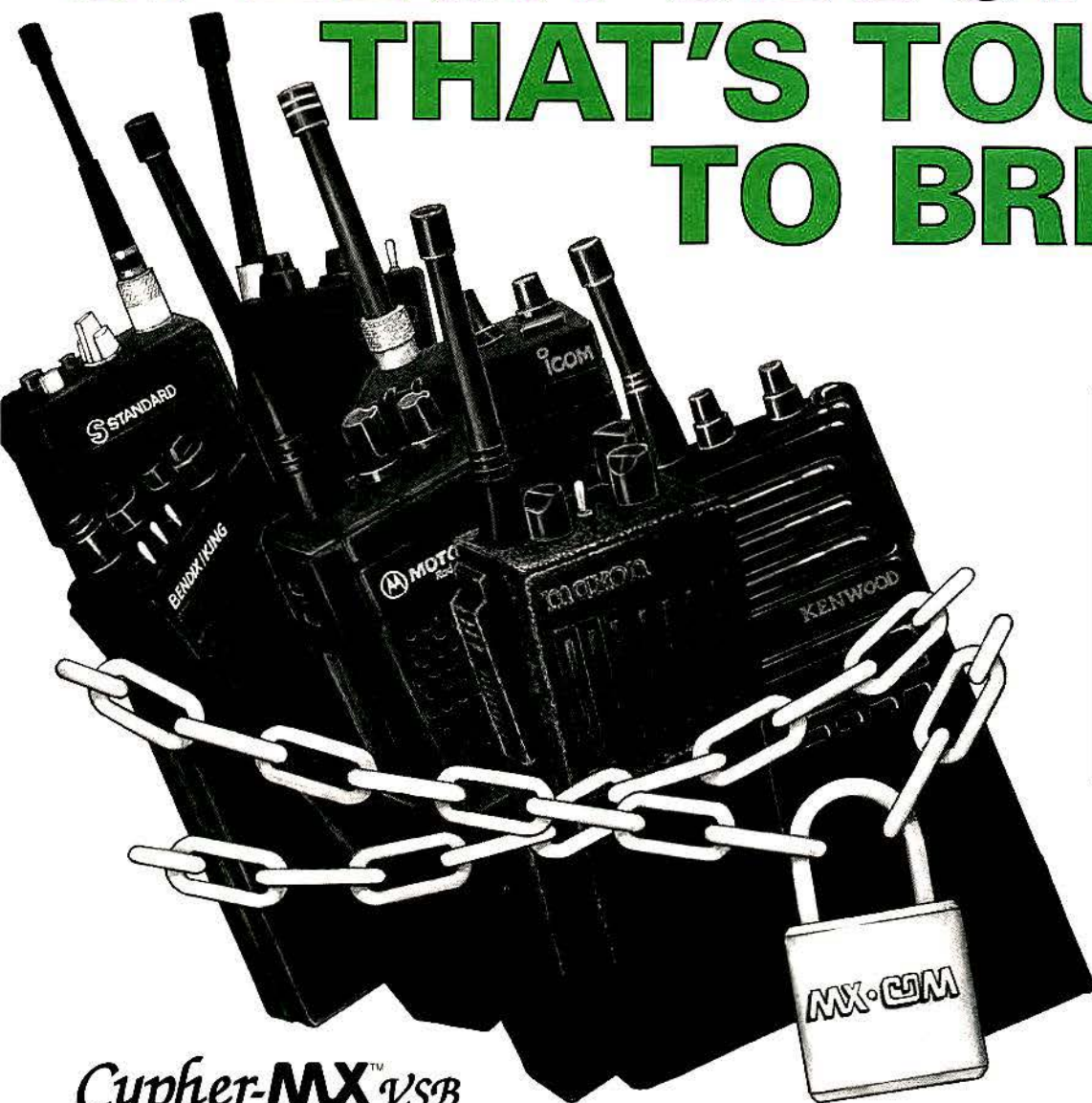


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Field intensity vs. signal level at the receiver

By Harold Kinley, C.E.T.

It is important to understand how field intensity units relate to actual signal level at the receiver input. Pager sensitivity is usually expressed in terms of microvolts per meter ($\mu\text{V}/\text{m}$) or decibels referenced to $1\mu\text{V}/\text{m}$ (dBu). Field strength contours are often expressed in dBu or $\mu\text{V}/\text{m}$. But what does it mean in terms of actual signal level at the receiver input, that is, in terms of μV or dBm in 50 Ω ?

Calibrated field strength meters (not relative field strength indicators) are not commonly found around the typical land mobile radio shop, but spectrum analyzers are. With a calibrated antenna, the spectrum analyzer reading in dBm can be converted into field intensity units in dBu or $\mu\text{V}/\text{m}$.

Commercial antennas are available for such measurements, but they are fairly expensive. Suitable antennas can be constructed as shown in Figure 1A and 1B below. The antenna in Figure 1A is better for VHF highband, whereas the one in Figure 1B is easily made for 450MHz—

470MHz or 800MHz applications.

When using such an antenna to determine field intensity from signal level in dBm (from the spectrum analyzer display), it is necessary to know the *antenna correction factor* (K) in decibels per meter (dB/m). The graph in Figure 2 on page 26 can be used to determine the antenna factor (in dB/m) for either a 75 Ω or 50 Ω antenna system. This graph is for unity gain antennas or 0dB referenced to a halfwave dipole (0dBd).

The antenna factor must be *adjusted* for gain antennas. Antenna gain (dBd) *decreases* the antenna factor, and antenna loss in dBd (negative gain) *increases* the antenna factor by an amount equal to the gain in dBd.

To adjust the antenna factor for antennas with gain, subtract the gain figure (dBd) from the antenna factor taken from the graph in Figure 2. For example, if the antenna factor taken from the graph in Figure 2 is 0dB/m and the antenna has a gain of 6dBd, then the adjusted antenna factor is -6dB/m.

The antenna factor for the antennas shown in Figure 1 can be determined from the graph in Figure 2. These antennas have a 75 Ω input impedance, so the antenna factor is read from the red 75 Ω line.

Suppose the antenna such as the one at Figure 1B is to be used at 450MHz. On the graph in Figure 2, locate 450MHz, follow the grid up to the red 75 Ω line and then left

to the dB/m scale. The antenna factor is +19dB/m. Watch the value sign—antenna factors can be negative or positive.

Now suppose this antenna were to be used in the setup shown in Figure 3 on page 26. Notice that an impedance-matching pad is used to match the 75 Ω antenna system to the 50 Ω spectrum analyzer input. This is a minimum-loss resistive pad with an insertion loss of 5.7dB.

If desired, a 75 Ω -to-50 Ω RF impedance-matching transformer (such as model 75ZT or 57ZT from JFW Industries of Indianapolis) could be used to provide the impedance match with less than 1dB insertion loss. The loss of this matching pad also must be taken into account. The procedure is probably best explained by an example using the graphs, which are analogs for computer-based calculations discussed at the conclusion.

Suppose the signal level on the spectrum analyzer is -70dBm at 450MHz. We already know (from Figure 2) that the antenna factor is +19dB/m. On the graph in Figure 4 on page 28, locate -70dBm on the inner black horizontal dBm scale. Move vertically to where -70dBm intersects the diagonal graph line. The inner vertical dBu scale reading at this point, at the right, is about +37dBu.

Because this graph is for an antenna factor of 0dB/m, we must adjust the reading

(continued on page 26)

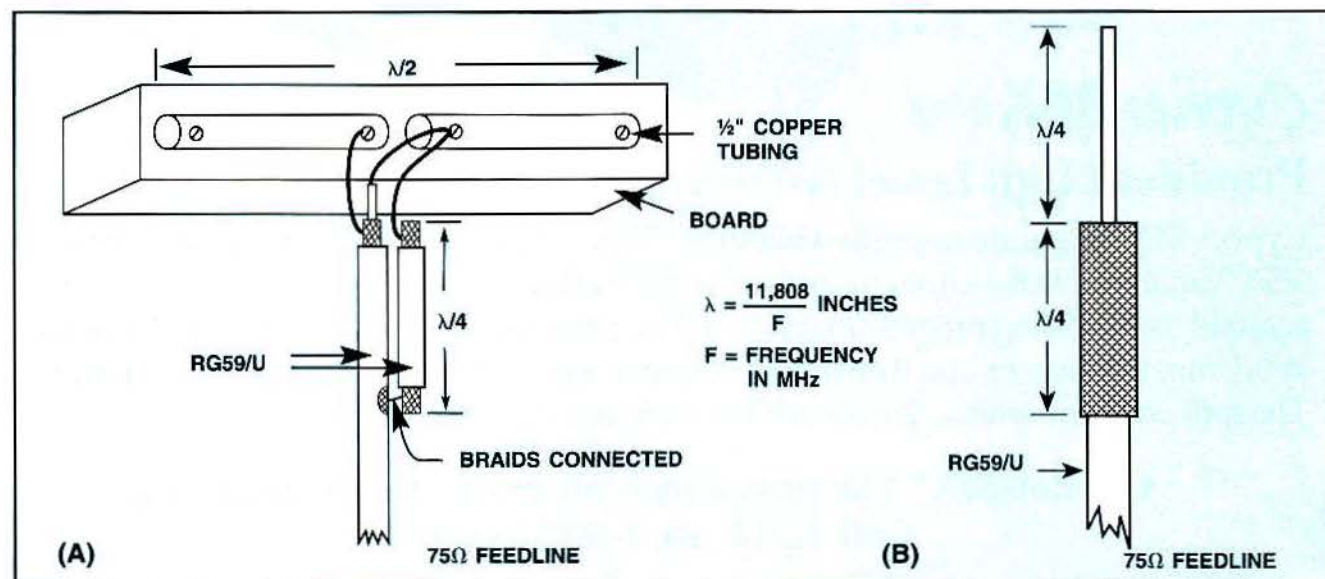
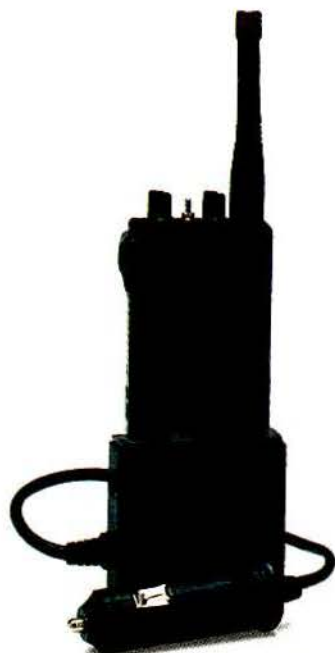


Figure 1. The wideband antenna (A) can be constructed easily with a board and 1/2" copper pipe. Because the antenna is balanced, a balun is needed to connect it to an unbalanced feedline. The balun is constructed as shown. This antenna is suitable for highband VHF. The other antenna

(B) is much simpler to construct for UHF and 800MHz applications. The braid is simply folded back over the outer jacket to form a halfwave dipole. For both antennas, the antenna factor (K) is found using the 75 Ω graph line (red) in Figure 2.

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Simon boasts multiple functions for mobile communications

Hand-held cellular telephone, wireless facsimile, pager, electronic mail, calendar, appointment scheduler, address book, calculator and pen-based note-and-sketch pad functions are integrated into one unit.

By Rich Guidotti

Simon, a portable cellular telephone designed by IBM and marketed by BellSouth Cellular, combines cellular telephony with multipurpose functions found on some computers.

The portable has a brightly lit liquid crystal display (LCD) touch-screen keypad on its face. The screen has a graphical user interface (GUI) with simple icons to help customers switch among applications easily. The unit measures 8 inches high, 2.5 inches wide and 1.5 inches thick.

Integrating functions

At the heart of the portable is a proprietary Intel-compatible x86 chip, redesigned for optimum performance in this application. The IBM system board designed for the new chip supports two integrated daughter boards. The result is a powerful device that moves smoothly from one function to another without wasting precious power resources.

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The portable comes with one megabyte

(1Mb) of random access memory (RAM) and 1Mb of flash read only memory (ROM), so its existing applications can be upgraded, and new functions can be added easily. Customers can add a 1Mb PCMCIA* memory card and a PCMCIA alphanumeric pager from MobileComm, BellSouth's nationwide paging company. Other options include an RJ-11 cable to connect to the landline telephone network; a customized care kit that turns the por-



The personal communicator's liquid crystal display (LCD) is a touch-screen graphical user interface (GUI). Notes may be handwritten with a special pen. Telephone numbers are dialed by touching numbers displayed on the screen as they would appear on a Touch-Tone dialing pad. Messages can be written by "typing" them into a "keyboard" on the LCD.

table into a hands-free cellular phone when driving; a cigarette lighter power receptacle adapter; and additional batteries.

Advanced power management

The cellular telephone transmits at a maximum of 0.6W, the same as other por-

table cellular phones, but it offers advantages over traditional hand-held wireless technology with its advanced power management. Powered by a rechargeable, replaceable NiCd battery, and backed up by an internal lithium battery, the portable is optimized to provide maximum power at the lowest possible power consumption by going into a standby, or "sleep," mode when not in use. The result is as much as eight hours of standby, or work, time and one hour of talk, or transmission, time.

For cellular calls, the portable works the same as a regular cellular phone, except that the customary keypad is displayed on the LCD screen. The phone includes a designated 9-1-1 emergency call button, last 10 numbers redial, dual-tone multiple-frequency (DTMF, or Touch-Tone) dialing, multiple number assignment modules (NAMs) that allow as many as four phone numbers to be assigned to the unit, simplified roaming instructions, and password protection.

The "address book" holds thousands of entries and lets customers choose a name and number, tap the screen and quickly place a call.

Fax and notepad

The portable also works as a 9,600bps, Group 3 fax machine. Its internal fax modem sends and receives as many as three pages directly from the LCD screen. (Longer faxes can be received and transmitted with the optional memory card).

Guidotti is a manager for new product development at BellSouth Cellular, Atlanta.

*Personal Computer Memory Card International Association.



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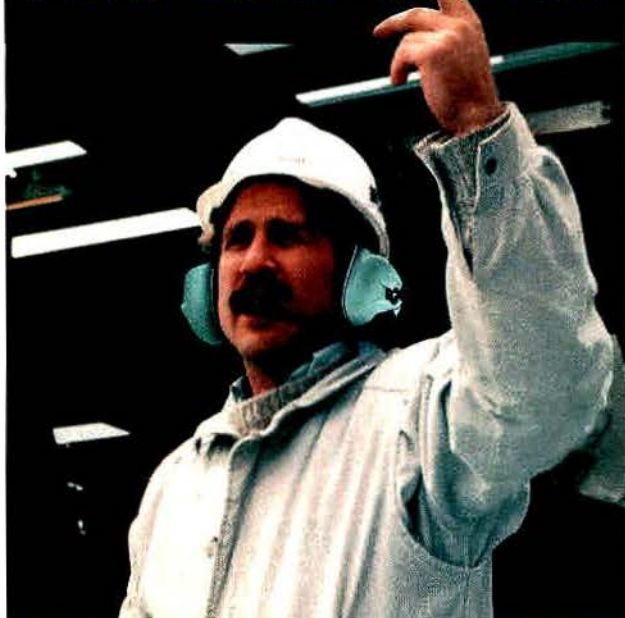
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Customers can create a fax either by writing on the screen with a provided stylus or by "typing" messages with the on-screen keyboard. A customer can hand-write comments on the original fax received and then re-send it, with the comments, over the cellular or landline network.

Customers can create memos, notes or drawings using the keyboard or by writing directly on the screen with the stylus. To do this, the portable uses a technology called *pen annotation*, which reflects the user's handwriting exactly; that is, the writing is not converted to a printed word. Pen annotation is ideal for jotting notes, drawing maps or sending a fax or memo.

Data entry

Data are entered in one of several ways. Skilled typists can use the on-screen QWERTY keyboard to type a message or to file a telephone number and address. But because most people "hunt and peck" on a keyboard, the unit offers a creative solution: a predictive keyboard.

After seven years of development, IBM has perfected an algorithm that predicts, with a 90%-95% accuracy, the next letter that most likely would be used. Using this

*Customers can create
memos, notes or
drawings using the
keyboard or by writing
directly on the screen
with the stylus.*

algorithm, the predictive keyboard shows six large keys at a time. Depending on which letter is chosen first, it predicts the next six most likely letters and displays them. This process lets the user type quickly, efficiently and comfortably without having to look for letters on a standard keyboard. In short order, users are typing faster and more easily.

Pager, E-mail and organizer

The personal communicator includes an internal cellular pager that receives and stores as many as nine phone numbers without any additional options or accessories. The *automatic call return* function allows users to dial the paging caller back simply by touching the screen. If a customer wants alphanumeric paging capability, an optional PCMCIA card is available from MobileComm.

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2. Shared Line: Subscribers assigned to the shared line receive incoming calls by overdialing. The mobile can be signalled using CTCSS, DCS, DTMF, Two Tone or 5/6 Tone (all standard). In addition six unique ringing sounds allow selective calling within a CTCSS or DCS code. Toll protection protects the system operator from abuse however selective overrides allow dialing to adjacent area codes if desired.

Interconnect and repeater time usage can be billed at different rates because the **TP-154 PLUS** accumulates these totals separately for each subscriber. All time and hit information as well as any programmed data can be retrieved over the air using our **CD-1** Decoder Unit (option).

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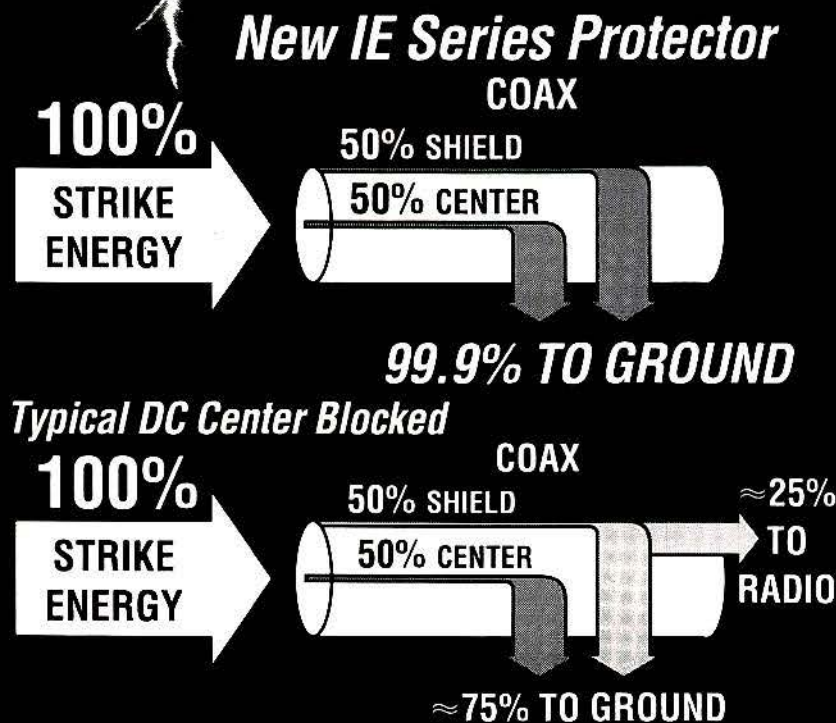
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With the internal, 2,400bps Hayes-compatible modem, the portable sends and receives electronic mail through any Lotus cc:Mail post office that supports remote dial-in. It can store the equivalent of as many as twenty 8½" × 11" pages of messages in its internal memory, allowing users to view, create or send saved messages. When the unit is equipped with MobileComm's PCMCIA messaging card, messages can be received through most public E-mail systems as well.

Because the portable communicator is designed for busy executives and people on the go, it includes an appointment scheduler; calendar; calculator; world clock with a wake-up alarm; an electronic directory that stores names, addresses and

Simon is, first and foremost, a personal communicator . . .

phone numbers that can be dialed with a touch of the number; and a *help* button on each screen to guide the user through the functions.

Market research

Through market research, customers said what features they want in a personal communicator. Attributes such as ease of use; numerous wireless communication functions; integrated, multiple applications; and on-line help are integrated into the unit because of market research.

Some personal communications products look as though their designers want them to be computers. Simon is, first and foremost, a personal communicator — because it smoothly combines multiple communications functions into a customer's busy life. It lets you leave your previous cellular phone, pager, address book, fax machine and E-mail terminal behind when you travel by shrinking all of these devices into one unit.

The portable was introduced in late 1993 in central Florida markets. A phased roll out was expected to offer it in other BellSouth Cellular markets by February 1994, and nationwide by the end of March 1994.

The unit carries a suggested retail price of \$899 in BellSouth Cellular markets.



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Servicing pagers: Frequencies, coding formats

Part 3—'Hooking up' customers so their pagers work on one of the various paging services in a given area is simple with the right equipment and information about crystal frequencies, receiver boards and decoder boards.

By David Ludvigson

Bravo pagers are built to receive paging messages sent in two types of digital code, POCSAG and Golay.

With the POCSAG code, some of the pager's silicon chips decode the slow drawl of 512 bits per second (bps). Other chips can decode at 1,200bps, and yet another version races along at 2,400bps.

Golay, on the other hand, operates at a single rate of speed, forcing all the needed data into a well-defined timeframe.

From the retailer's point of view, this description summarizes all he needs to know about Bravo pager decoder boards. With this information and a 10-power magnifying lens, he has just about mastered the Bravo decoder. At the end of this article, we will hand him his degree.

Previous articles in this series have shown how a modest investment provides a signal generator, a POCSAG-Golay code generator, the radiation test fixture, the IFFER IF strip testing device and a do-it-yourself shielded room—everything neces-

Ludvigson is a technician in Houston.

sary to handle service and repairs. An air-time supplier such as Pagenet or Pagemart can provide pagers, capcodes, beeper numbers and, often, the necessary crystals to put Bravo pagers on their frequencies. Programmers for Bravo, Bravo Plus, and Bravo Express are available from Motorola.

Capcodes and pager telephone numbers usually come in pairs. The pager telephone number is the usual seven-digit number that the caller dials from a Touch-Tone telephone. Capcodes usually contain either six digits or seven digits: six digits for Golay codes (sometimes followed by the letter "F"), or seven digits for POCSAG.

Golay codes often are used on paging systems using radio frequencies below 450MHz, and POCSAG generally is used (at varying speeds) above 150MHz.

The frequencies and formats chosen by a retailer must reflect both what pagers he sells and what pagers come in for a "hookup." If a customer wants a hookup for a pager crystallized to 152.24 MHz (with a POCSAG 512 decoder), the retailer probably will want to re-crystal the pager to "his" frequency of, say, 152.84MHz, for example, where the POCSAG 512 format is used, too.

In Houston, three paging carriers served

by JJ Sounds operate POCSAG systems between 929MHz and 932MHz. All of them provide 1,200bps service. In addition, one provides 512bps service and another provides 2,400bps service, and they *all* want me to "hookup" customers!

The Bravo pager is well-designed. It is modular—it has two circuit boards: One is a receiver, and the other is the decoder. The modular construction allows the retailer to remove the receiver from the decoder to customize the entire unit to the retailer's frequency and format.

Several tables are provided on page 18 for those using the 930MHz Bravo. These tables are used to determine the operating frequency of Bravo pagers merely by looking at the first conversion oscillator and second conversion oscillator crystal frequencies.

The first intermediate frequencies are either 17.9MHz or 45.00MHz. Determining the first conversion oscillator frequency is a matter of simple math:

$$[(\text{receiver frequency}) - (\text{first IF frequency})] / 12 = \text{first conversion crystal frequency.}$$

Up to this point, you are dealing with a fairly common radio receiver. The big difference is in the triple-conversion superhetrodyne circuit that provides a narrow-bandwidth receiver capable of "ignoring" other transmitters operating close to the same frequency.

The detector used in the Bravo provides several useful outputs, each of which is metered easily by the "flap" of the RTL-1005 test fixture. Astute technicians will note an audio output pin (TP6) and question the use of the IFFER for alignment rather than this test point.

The IFFER simply provides greater gain at 455kHz, thus allowing a pager to be drastically mis-tuned and still have enough signal to perform "brute-force" alignments.

Data out and data in lines go to and from

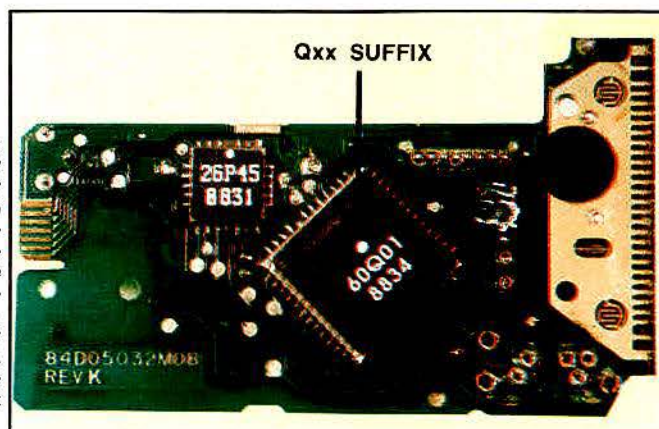
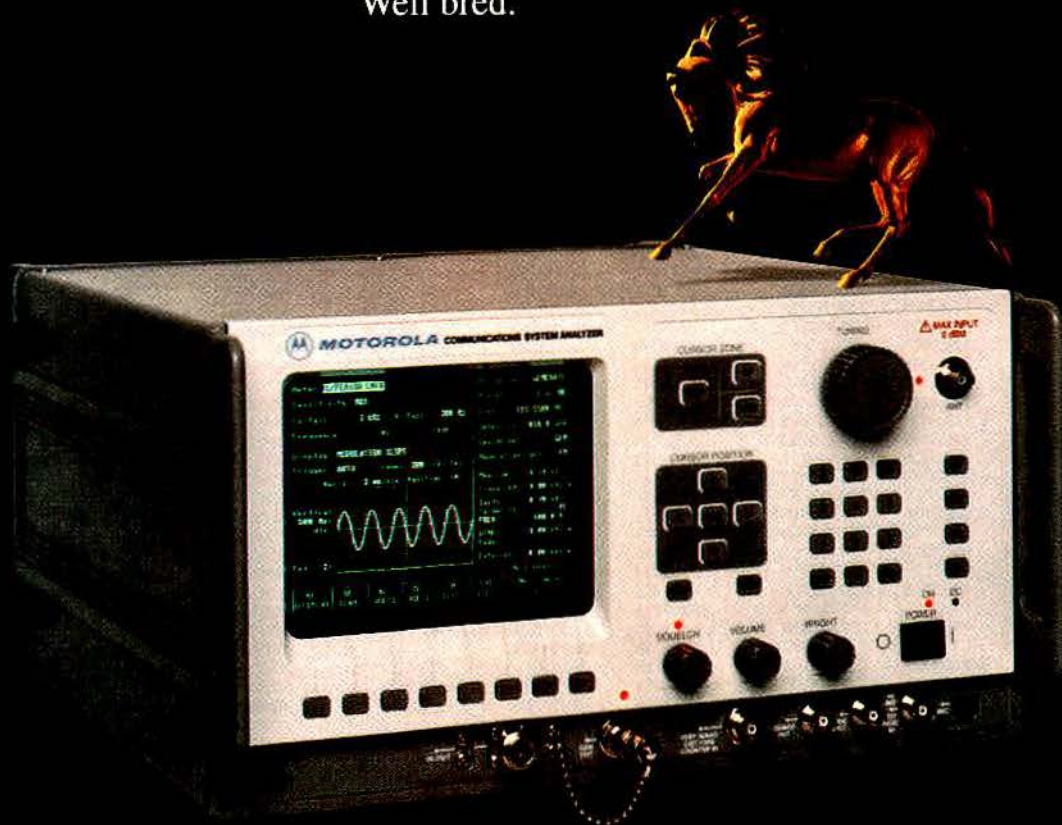


Photo 1. The suffix of the identification number printed on the decoder microprocessor is known as the Qxx suffix because it includes the letter Q and two digits. The suffix indicates the micro-processor's paging 'language' (POCSAG or Golay) and speed. A table in the text gives the language and speed that go with each suffix.

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The sculptured horse, "Magnificent Beast", is the work of George-Ann Tognoni, Phx., AZ.



MOTOROLA

Table 1—KXN6370A (Y501) Oscillator Frequencies

Carrier Freq. (MHz)	1st Osc. Freq. (MHz)	930.5125	76.051042
929.0125	75.926042	930.5375	76.053125
929.0375	75.928125	930.5625	76.055208
929.0625	75.930208	930.5875	76.057292
929.0875	75.932292	930.6125	76.059375
929.1125	75.934375	930.6375	76.061458
929.1375	75.936458	930.6625	76.063542
929.1625	75.938542	930.6875	76.065625
929.1875	75.940625	930.7125	76.067708
929.2125	75.942708	930.7375	76.069792
929.2375	75.944792	930.7625	76.071875
929.2625	75.946875	930.7875	76.073958
929.2875	75.948958	930.8125	76.076042
929.3125	75.951042	930.8375	76.078125
929.3375	75.953125	930.8625	76.080208
929.3625	75.955208	930.8875	76.082292
929.3875	75.957292	930.9125	76.084375
929.4125	75.959375	930.9375	76.086458
929.4375	75.961458	930.9625	76.088542
929.4625	75.963542	930.9875	76.090625
929.4875	75.965625	931.0125	76.092708
929.5125	75.967708	931.0375	76.094792
929.5375	75.969792	931.0625	76.096875
929.5625	75.971875	931.0875	76.098958
929.5875	75.973958	931.1125	76.101042
929.6125	75.976042	931.1375	76.103125
929.6375	75.978125	931.1625	76.105208
929.6625	75.980208	931.1875	76.107292
929.6875	75.982292	931.2125	76.109375
929.7125	75.984375	931.2375	76.111458
929.7375	75.986458	931.2625	76.113542
929.7625	75.988542	931.2875	76.115625
929.7875	75.990625	931.3125	76.117708
929.8125	75.992708	931.3375	76.119792
929.8375	75.994792	931.3625	76.121875
929.8625	75.996875	931.3875	76.123958
929.8875	75.998958	931.4125	76.126042
929.9125	76.001042	931.4375	76.128125
929.9375	76.003125	931.4625	76.130208
929.9625	76.005208	931.4875	76.132292
929.9875	76.007292	931.5125	76.134375
930.0125	76.009375	931.5375	76.136458
930.0375	76.011458	931.5625	76.138542
930.0625	76.013542	931.5875	76.140625
930.0875	76.015625	931.6125	76.142708
930.1125	76.017708	931.6375	76.144792
930.1375	76.019792	931.6625	76.146875
930.1625	76.021875	931.6875	76.148958
930.1875	76.023958	931.7125	76.151042
930.2125	76.026042	931.7375	76.153125
930.2375	76.028125	931.7625	76.155208
930.2625	76.030208	931.7875	76.157292
930.2875	76.032292	931.8125	76.159375
930.3125	76.034375	931.8375	76.161458
930.3375	76.036458	931.8625	76.163542
930.3625	76.038542	931.8875	76.165625
930.3875	76.040625	931.9125	76.167708
930.4125	76.042708	931.9375	76.169792
930.4375	76.044792	931.9625	76.171875
930.4625	76.046875	931.9875	76.173958
930.4875	76.048958		

$$F_c = 12F_o + 17.9\text{MHz}$$

$$\text{2nd Osc. Freq.} = 17.445\text{MHz}$$

NOTE

This table applies to KXN6370A crystals (Y501) which are used in Bravo pagers with receiver board kit number NRF4071A-D **ONLY**. Bravo pagers with receiver board kit number NRF4071E use KXN3000A crystals.

IMPORTANT: Y501 1st Oscillator Crystal and C517 must be replaced as a pair per this table:

Grp.	Crystal Marking Color Code		EIA Marking Code	C517 Markings			
				Color Code		C517 Part Number	
	1st Dot	2nd Dot		1st Dot	2nd Dot		
1	Black	None	COG	O R	Black	None	2182358G41
2	Violet	None	U2J		Violet	None	2182358G46
3	Orange	Orange	P3K		Orange	Orange	2182358G48
4	Yellow	Orange	R3A		Yellow	Orange	2182358G49
5	No Markings		P3K		Orange	Orange	2182358G48

NOTE: Failure to replace Y501 and C517 as a pair could result in radio sensitivity at the temperature extremes of operation.

Table 2—NXN3000A (Y551) Oscillator Frequencies

Carrier Freq. (MHz)	1st Osc. Freq. (MHz)	930.5125	73.79270
929.0125	73.66770	930.5375	73.79479
929.0375	73.66979	930.5625	73.79687
929.0625	73.67187	930.5875	73.79895
929.0875	73.67395	930.6125	73.80104
929.1125	73.67604	930.6375	73.80312
929.1375	73.67812	930.6625	73.80520
929.1625	73.68020	930.6875	73.80729
929.1875	73.68229	930.7125	73.80937
929.2125	73.68437	930.7375	73.81145
929.2375	73.68645	930.7625	73.81354
929.2625	73.68854	930.7875	73.81562
929.2875	73.69062	930.8125	73.81770
929.3125	73.69270	930.8375	73.81979
929.3375	73.69479	930.8625	73.82187
929.3625	73.69687	930.8875	73.82395
929.3875	73.69895	930.9125	73.82604
929.4125	73.70104	930.9375	73.82812
929.4375	73.70312	930.9625	73.83020
929.4625	73.70520	930.9875	73.83229
929.4875	73.70729	931.0125	73.83437
929.5125	73.70937	931.0375	73.83645
929.5375	73.71145	931.0625	73.83854
929.5625	73.71354	931.0875	73.84062
929.5875	73.71562	931.1125	73.84270
929.6125	73.71770	931.1375	73.84479
929.6375	73.71979	931.1625	73.84687
929.6625	73.72187	931.1875	73.84895
929.6875	73.72395	931.2125	73.85104
929.7125	73.72604	931.2375	73.85312
929.7375	73.72812	931.2625	73.85520
929.7625	73.73020	931.2875	73.85729
929.7875	73.73229	931.3125	73.85937
929.8125	73.73437	931.3375	73.86145
929.8375	73.73645	931.3625	73.86354
929.8625	73.73854	931.3875	73.86562
929.8875	73.74062	931.4125	73.86770
929.9125	73.74270	931.4375	73.86979
929.9375	73.74479	931.4625	73.87187
929.9625	73.74687	931.4875	73.87395
929.9875	73.74895	931.5125	73.87604
930.0125	73.75104	931.5375	73.87812
930.0375	73.75312	931.5625	73.88020
930.0625	73.75520	931.5875	73.88229
930.0875	73.75729	931.6125	73.88437
930.1125	73.75937	931.6375	73.88645
930.1375	73.76145	931.6625	73.88854
930.1625	73.76354	931.6875	73.89062
930.1875	73.76562	931.7125	73.89270
930.2125	73.76770	931.7375	73.89479
930.2375	73.76979	931.7625	73.89687
930.2625	73.77187	931.7875	73.89895
930.2875	73.77395	931.8125	73.90104
930.3125	73.77604	931.8375	73.90312
930.3375	73.77812	931.8625	73.90520
930.3625	73.78020	931.8875	73.90729
930.3875	73.78229	931.9125	73.90937
930.4125	73.78437	931.9375	73.91145
930.4375	73.78645	931.9625	73.91354
930.4625	73.78854	931.9875	73.91562
930.4875	73.79062		

$$F_c = 12F_o + 45\text{MHz}$$

$$\text{2nd Osc. Freq.} = 44.545\text{MHz}$$

NOTE

This table applies to NXN3000A crystals (Y551) which are used in Bravo pagers with receiver board kit number NRF4071E **ONLY**. Bravo pagers with receiver board kit number NRF4071A-D use KXN6370A crystals.

IMPORTANT: Y551 1st Oscillator Crystal and C567 must be replaced as a pair per this table:

Grp.	Crystal Marking Color Code		C567 Markings				
			EIA Marking Code	Color Code		C567 Part Number	
	1st Dot	2nd Dot		1st Dot	2nd Dot		
1	Black	None	COG	O R	Black	None	2182358G41
2	Violet	None	U2J		Violet	None	2182358G46
3	Orange	Orange	P3K		Orange	Orange	2182358G48
4	Yellow	Orange	R3A		Yellow	Orange	2182358G49
5	No Markings		P3K		Orange	Orange	2182358G48

NOTE: Failure to replace Y551 and C567 as a pair could result in radio sensitivity at the temperature extremes of operation.



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CELWAVE
DIVISION OF RADIO FREQUENCY SYSTEMS INC.

an 8-pin connector. At this point, the receiver circuitry ends, and the next step is to look at filters and decoders, which are on the second board.

Decoders

Motorola Bravo pagers use dedicated silicon chips to decode either POCSAG or Golay formats.

These same chips provide output signals to the liquid crystal display (LCD) and

control signals to make the pager beep or vibrate. They also have been programmed to respond to various portions of an encoded signal train.

A review of these decoders' schematic diagrams will convince a technician quickly that everything here is only a matter of time—or *timing*. Again, Motorola has simplified this technical wonderland by marking each microprocessor with an easily converted code number. It starts with

5105860 and has a suffix of *Qxx*, where *xx* is a number between 01 and 16. (See Photo 1 on page 16.)

The following table indicates the "language" and speed of the various processors.

PROCESSOR	LANGUAGE	SPEED
Q01	Golay	
Q04	POCSAG	512bps
Q06	POCSAG	512bps
Q07	POCSAG	1,200bps
Q08	Golay	
Q10	POCSAG	512bps
Q11	POCSAG	1,200bps
Q12	Golay	
Q14	POCSAG	512bps
Q15	POCSAG	1,200bps
Q16	Golay	

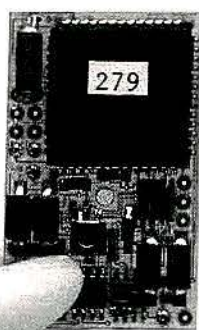
This table, along with a list of frequencies and formats supplied by the airtime vendor, is indispensable for determining rapidly the feasibility of hooking up Bravo pagers.

In Houston, JJ Sounds has signed on with three big airtime suppliers. They operate on the following frequencies and formats:

152.24MHz	Golay	
152.84MHz	POCSAG	512bps
454.10MHz	Golay	
929.6625MHz	POCSAG	1,200, 512bps
929.7125MHz	POCSAG	1,200bps
931.2875MHz	POCSAG	2,400, 1,200bps
931.4875MHz	POCSAG	1,200, 512bps
931.6875MHz	POCSAG	1,200bps

With a *frequency and format chart*, programming Bravo pagers becomes a process of matching crystals to the operating frequency needed, matching a receiver board to a decoder board and then heading to the Bravo Programmer.

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"Servicing Pagers: Build a Shielded Room," January 1994.

"Servicing Pagers: Build An 'IFFER'," February 1994.

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Acknowledgement

I would like to thank J.H. Kim, owner of JJ Sounds, South Houston, TX, and co-workers Raymond, Tim and Pete, for their help with this project.



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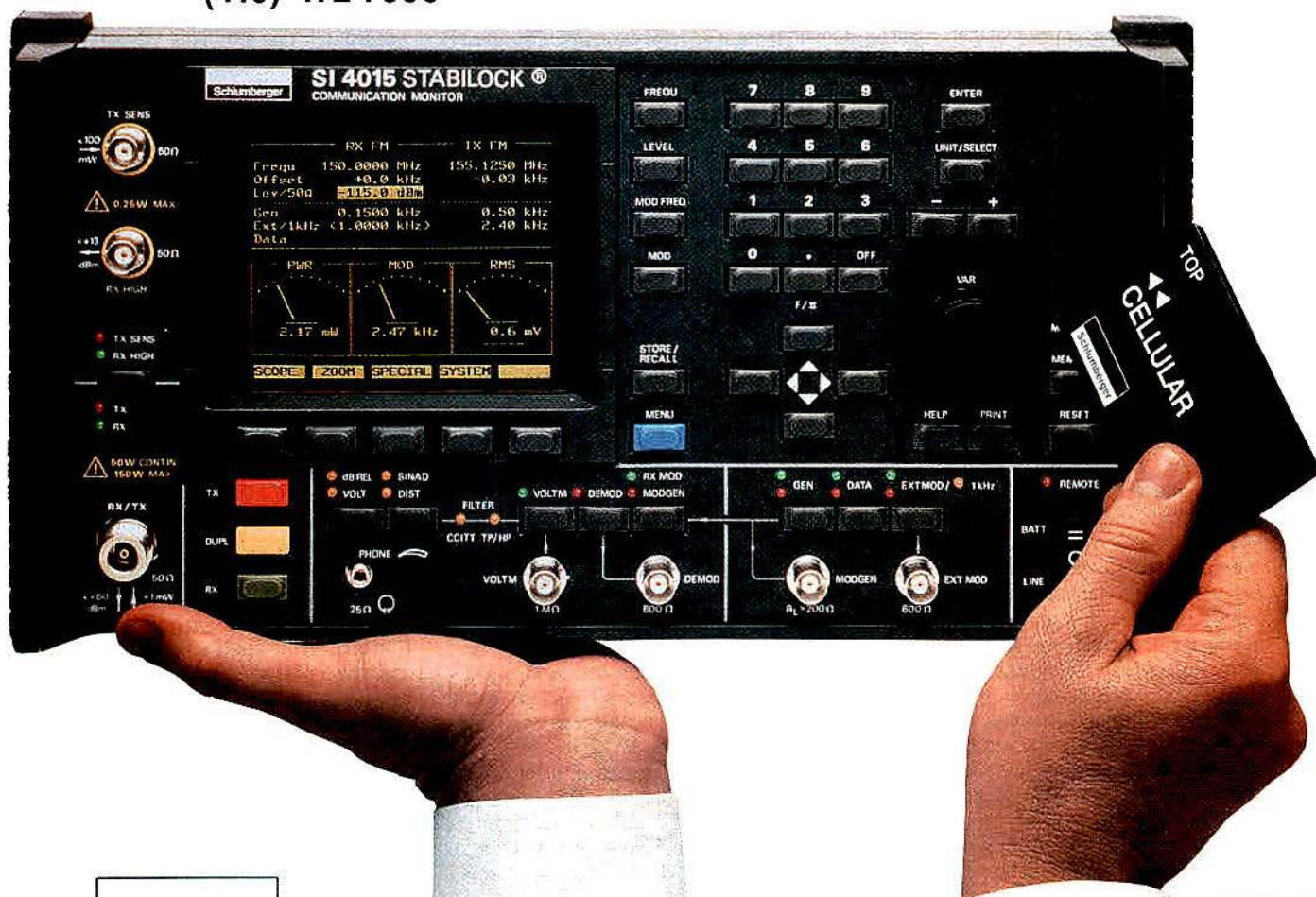
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Quality management uncovers hidden costs

Part 3—A service facility or communications provider can put quality management to work to uncover hidden costs that limit profitability and ultimately threaten survival. Eliminating waste makes the difference.

By Donald E. Koehler

Finding hidden costs in any business can be difficult.

Waste accounts for nearly 30% of manufacturing costs, according to Dr. W. Edwards Deming, author of *Out Of The Crisis* and several other books on using statistical analysis as a management tool. As if that were not bad enough, Dr. Deming says that waste accounts for more than 70% of costs associated with white-collar work products.

Part 1 in this series (January 1994 issue) explains that quality management (QM), as it applies to servicing radio communications systems, includes gathering data on reactive, preventive, performance-based and cost-based maintenance procedures. Analyzing the data uncovers hidden costs in doing business; reduces radio and system downtime with the use of performance-based maintenance; provides your sales force with a powerful tool; and allows better resource allocation based on demonstrated need.

Part 2 (February 1994 issue) describes automated data capture systems that help service facilities and communications providers to gather and analyze information for quality management. Performance reports help sales efforts, too.

The next step is to show how QM implementation in your company, service department or agency pays you back.

Philip B. Crosby, in his book *Quality Without Tears*, writes that quality is free—and he is correct.

A QM program eliminates waste, reducing costs and therefore boosting profit

more than enough to offset the expense of the program.

Customers

Know your customer.

As basic as that statement may seem, some communications providers and service centers do not know or understand their customers. It is easier for small businesses to know their customers, which gives them an edge over larger companies.

In large agencies, corporate supply and maintenance divisions and other large businesses, the customer may not be so easy to

harder with the agency so the customer and I could discover his real needs early on, the wasted time could have been put to better use.

Customer education is the first step in stopping waste. In many cases, especially in large organizations, you must help the customer to understand exactly what is needed for the job. This education must include what you can and cannot do for the customer.

Customer relations

Once you have the customer and you understand his needs, make sure the customer knows you.

Build on this understanding to form a long-term, high-quality relationship. The customer benefits by having expert resources available, and you benefit by being able to meet the customer's needs with less waste and more profit. These benefits are the reason why Dr. Deming deplors the *lowest bid mentality*. People are willing to pay for the necessary quality. Work with your customer to provide the necessary quality.

In large agencies or companies, the customer sometimes is harder to find and to define. Maintenance organizations that provide internal support often are victims of the *customerless product syndrome*. Repaired items are placed back in "stock" and then passed to any number of end-users.

In this case, the boss may have to be considered the customer. Maintenance supervisors or shop foremen have to set the quality standard.

For items with an identified end-user, talk with the user. The better you understand each other, the better you do business. The user may benefit from your knowledge, resulting in fewer repairs. In the world of shrinking agency budgets, it may be the only way to survive.

Larger agencies are switching from in-

In many cases, you must help the customer to understand exactly what is needed for the job.

define. Decision-makers receive information filtered by sales and customer service staff members, or they may simply lack an understanding of the customers' needs.

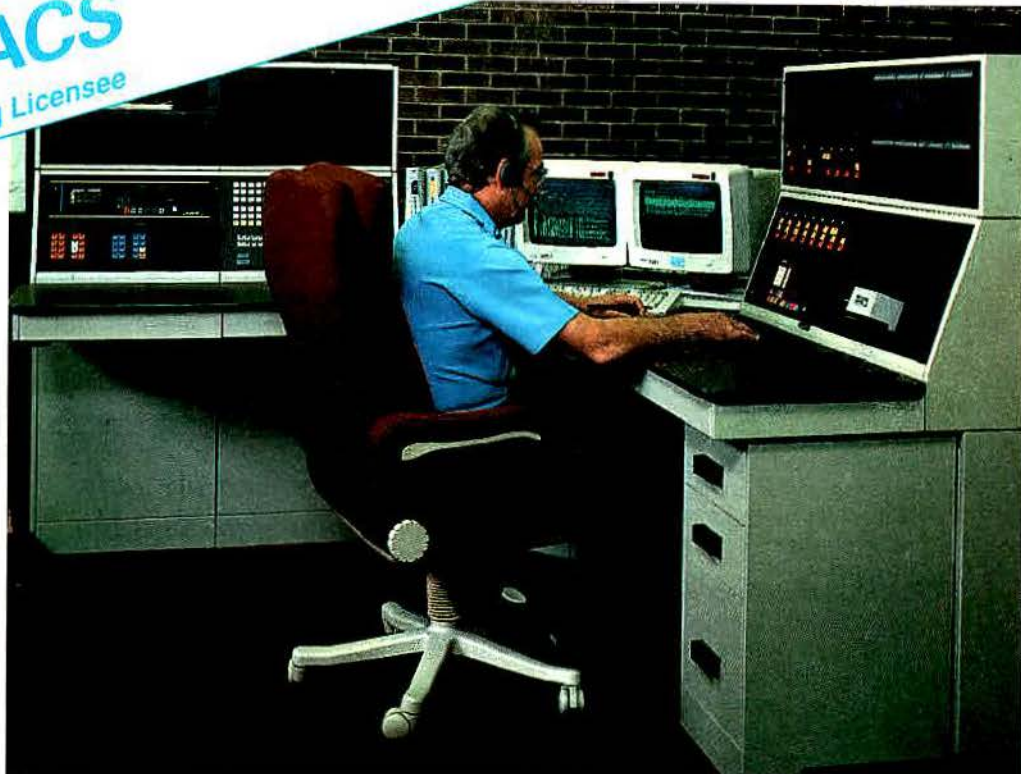
To eliminate waste, decision-makers, from the maintenance technicians to the boss, should know and understand what the customers really need.

For example, I once spent a lot of time setting up a *flat* database for an agency, only to get repeated calls for help from the customer. After further discussions, I changed the flat database to a *relational* database.

The customer did not know the difference between a flat and a relational database, he only knew what results he wanted the database to achieve. Had I worked

Koehler is a technical writer, technical resource researcher, and computer, communications and database specialist for Hartec Management Consultants, Anchorage, AK.

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ternal cost-center repair to outsourcing or contract repair. The better you understand and support the internal customer, the less likely the agency managers will look outside.

Training

Training costs cut both ways.

The management needs training on new technology and processes just as the technical support team does. Training on new processes often is viewed as a *worker only* expense and is given reluctantly. New technology is approached with extreme caution. Often it is viewed as a risky investment.

This attitude hurts companies twice.

The technical support staff members see the job as a dead end, with little chance to improve their knowledge.

They are forced to learn new equipment and processes the hard way—by trial and error. Trial and error is expensive.

An Air Force sergeant once explained to me that a person's ability to fix radios was inversely proportional to the number of radios he burned up in training. This is an exaggeration, but it serves to point out that self-training really is expensive because of low productivity, damaged equipment, in-

creased repair costs and long turnaround times—waste, in other words.

Worker retention and support

Professional training on new technology allows for increased productivity and serves to increase worker morale.

If a person believes he cannot do a good job, he will not do a good job. A well-

Managers who are able to communicate with the technical staff about the technology in use really can energize an organization.

trained person will believe he can do a good job, and he generally does.

Training can increase worker retention. The well-trained worker knows the company trusts him and sees his future potential. The more the management staff mem-

bers understand the technology in use, the more receptive they are to new ideas. Managers who are able to communicate with the technical staff about the technology in use really can energize an organization.

The company or organization that really understands and meets their customers' needs and gains a long-term relationship with its customers will succeed.

An organization that trains, trusts and listens to its technical staff will continue to enjoy that success, and it will be reflected in the elimination of waste in the work process and in increased profits.

A quality management program may sound hard to design and expensive to implement. Its success requires that everyone in the organization participate.

Quality management gives you the edge to do more than survive. For agencies faced with shrinking budgets, it makes the difference between their continued ability to deliver services or their being replaced.

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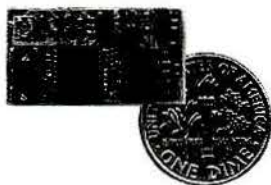
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(continued from page 8)

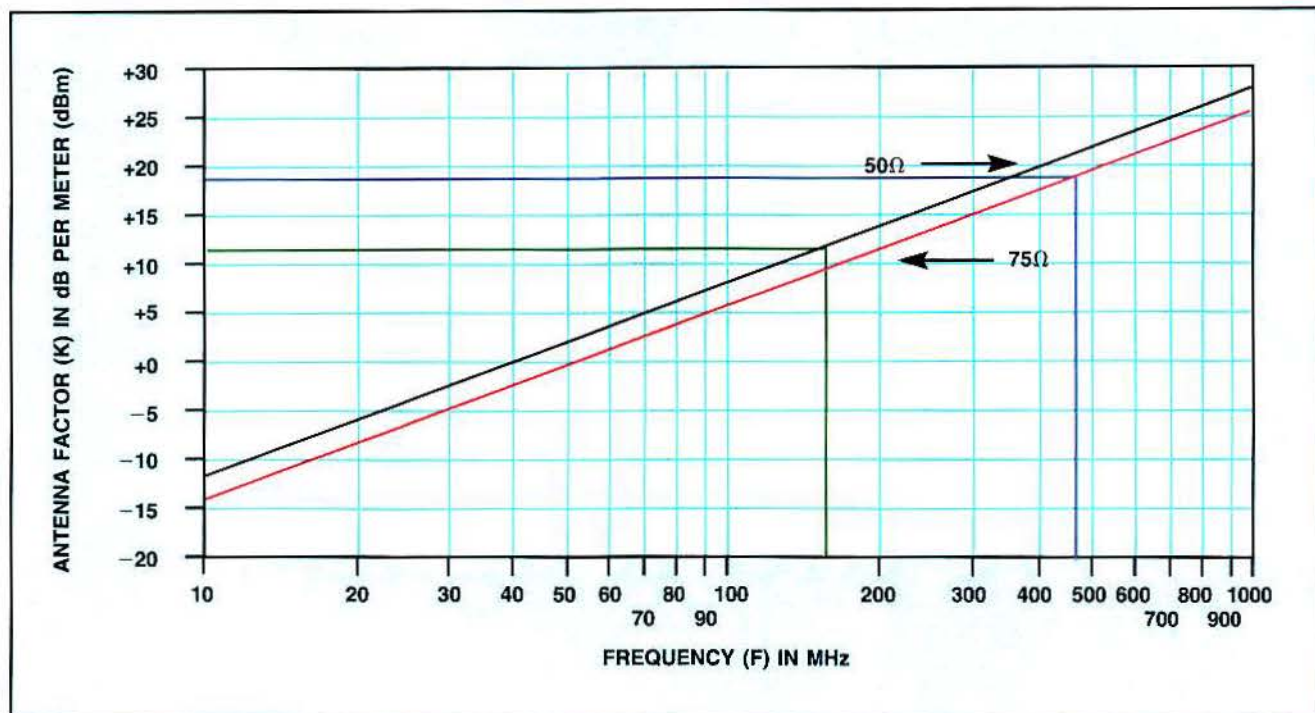
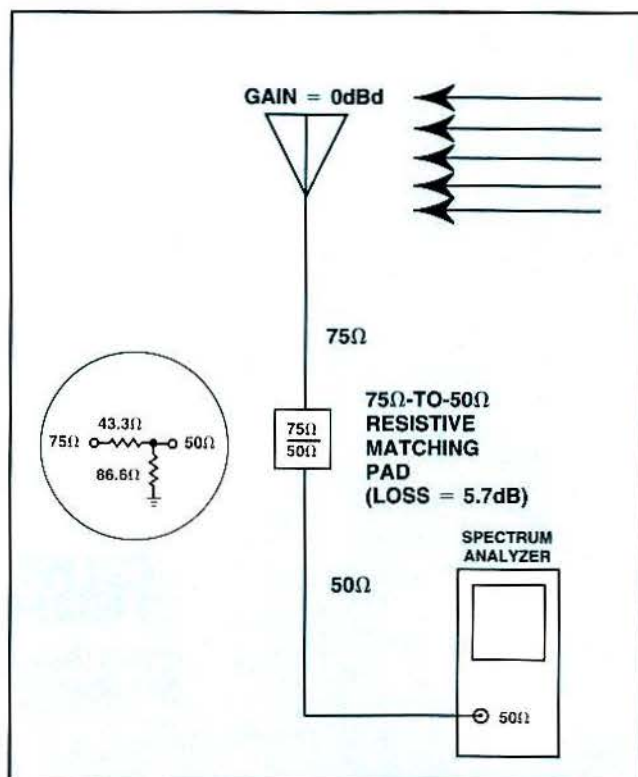


Figure 2. Before using an antenna to measure field intensity, the antenna correction factor (K) must be known. The antenna factor can be determined from this graph. Use the red graph for 75Ω antenna systems and the black graph for 50Ω antenna systems. These graphs are for antennas with a gain of 0dBd (0dB referenced to a halfwave dipole). If the antenna has gain, then the antenna factor from this graph must be adjusted to compensate. To find the adjusted antenna factor, subtract the gain in

dBd from the antenna factor taken from the graph. For example, if a 6dBd-gain, 50Ω antenna were used for field intensity measurements at 465MHz, the antenna correction factor for the corresponding unity-gain (0dBd) antenna would be about 21.3dBm. The adjusted antenna correction factor, therefore, is $21.3 - 6$, or 15.3dB/m. The blue and green lines exemplify the cases for a 75Ω system used at 450MHz and a 50Ω system used at 150MHz as described in the article.

Figure 3. A 75Ω antenna system is used with a 50Ω spectrum analyzer input to make field intensity measurements. A resistive impedance-matching pad with an insertion loss of 5.7dB matches the 75Ω antenna to the 50Ω spectrum analyzer input. The inset diagram shows the resistive pad's construction. The antenna factor is determined from the 75Ω line in Figure 2. The impedance-matching pad's loss and the antenna factor (K) must be taken into account when determining field intensity from the dBm level on the spectrum analyzer. Also, any line loss must be taken into account.



by adding the antenna factor (+19dB/m) to get +56dBu ($19 + 37$). The loss of the impedance-matching pad also must be taken into account. Add this figure to 56dBu to get 61.7dBu ($56 + 5.7$). The 61.7dBu figure is off the inner (black) scale, so find 61.7dBu near the bottom of the outer (red) scale. Reading across, we see this measurement corresponds to a field intensity of about 1,200μV/m on the outer (red) μV/m scale at the left.

Figure 5 on page 30 shows a setup using a 50Ω antenna system with 6dBd gain. Assume that the spectrum analyzer is being used to measure the level of a signal at 150MHz. The antenna factor from the graph in Figure 2 for a 50Ω system at 150MHz is +11.5dB/m.

Because the antenna in Figure 5 has a gain of 6dBd, we must adjust the antenna factor by subtracting the antenna gain in dB from the 0dBd-gain antenna factor (+11.5dB/m). The adjusted antenna factor becomes $+11.5 - 6 = +5.5$ dB/m.

Suppose the spectrum analyzer reading is -80dBm. Using the graph in Figure 4, locate -80dBm on the horizontal scale. Move up to the graph line and over to 27dBu on the inner scale at the right. Ad-

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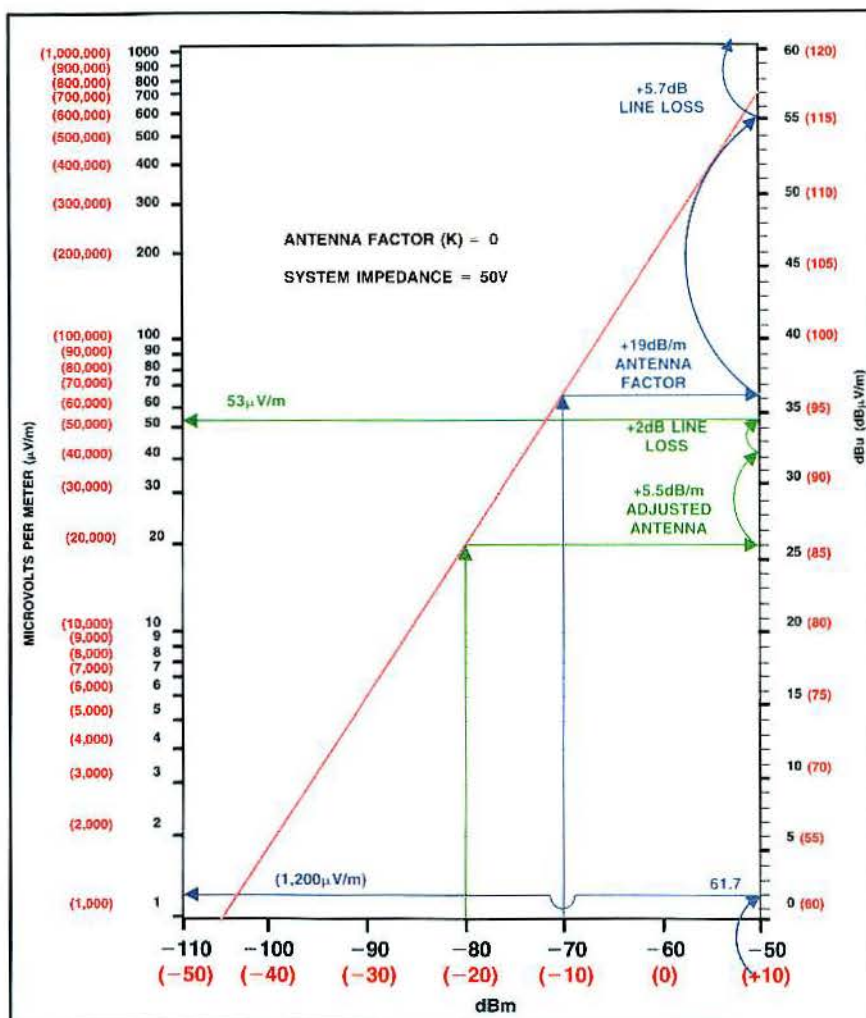


Figure 4. This graph can be used to convert dBm levels on the spectrum analyzer to field intensity levels in dBu or $\mu\text{V/m}$. This graph is for an antenna correction factor of 0dB/m. When converting from signal level (dBm) to field intensity (dBu or $\mu\text{V/m}$), the antenna correction factor is added (algebraically, observing signs) to the dBu figure, and any loss (such as line loss and matching pad loss) is added to

the dBu figure. When converting from field intensity levels (dBu or $\mu\text{V/m}$) to signal levels (dBm), the antenna correction factor is subtracted (algebraically) from the dBu figure. Any losses are also subtracted (algebraically) from the dBu figure. The blue and green lines exemplify using the graph to derive $\mu\text{V/m}$ for a 75 Ω and a 50 Ω system as described in the article.

just for the antenna factor and line loss. Add the antenna factor and line loss to 27dBu to get $27 + 5.5 + 2 = 34.5\text{dBu}$, or about $53\mu\text{V/m}$ on the inner scale at the left.

The graph in Figure 4 can be used to convert from signal level at the receiver input to field intensity at the antenna or the reverse—field intensity at the antenna to signal level at the receiver input. Some examples will clarify the many uses of the graph in Figure 4.

The specification states that the 20dB quieting sensitivity of a pager is $25\mu\text{V/m}$ in terms of field intensity or $0.5\mu\text{V}$ at the receiver RF input jack. The frequency is 150MHz. Because pager antennas are located inside the small pager housing, they are necessarily very lossy. Compared to a halfwave dipole, a pager antenna might

have a gain of -25dBd or so. (A negative gain is a loss!)

We do not know the pager antenna gain compared to a halfwave dipole, but we can determine it with the Figure 4 graph. The ratio of the required field intensity ($\mu\text{V/m}$) to the required signal level at the receiver input for 20dB quieting is $25\mu\text{V/m}$ to $0.5\mu\text{V}$ or 50:1. On the Figure 4 graph, locate 50 on the left inner scale. Follow the horizontal grid right to the inner dBu scale at about 34dBu.

From Figure 2, the antenna factor for a 0dBd gain antenna at 150MHz (50 Ω) is $+11.5\text{dB/m}$. Now, subtract the 34dBu reading from the antenna factor ($+11.5\text{dB/m}$) to yield: $11.5 - 34 = -22.5\text{dB}$, which is the gain of the pager antenna in dBd.

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A negative gain is a loss, so the pager antenna has a loss of 22.5dB compared to a halfwave dipole. We might say the pager antenna has a "handicap" of 22.5dB.

Here is another example. Suppose that a receiver operating at 450MHz is connected to an antenna with 6dBd gain. The field intensity at the antenna is $10\mu\text{V/m}$. The line loss is 2dB, and the system impedance is 50Ω throughout. What is the signal level at the receiver input in dBm?

First, find the antenna factor from Figure 2. At 450MHz the antenna factor is +21dB/m. The antenna gain (6dBd) must be subtracted to give an adjusted antenna factor of $21 - 6 = 15\text{dB/m}$.

Next, on the Figure 4 graph, locate $10\mu\text{V/m}$ on the left inner scale and follow the horizontal grid to 20dBu on the right inner vertical scale. Now subtract the antenna factor and the line loss to yield: $20 - 15 - 2 = 3\text{dBu}$, or about $1.42\mu\text{V}$ on the left inner scale.

To obtain the signal level in dBm, follow the horizontal grid right to the diagonal graph line and then the vertical grid down to the inner horizontal scale at about -104dBm. Thus, the scales can be used to convert between dBm and μV very easily. For example: $10\mu\text{V} = -87\text{dBm}$.

The scales also can be used to convert voltage ratios to decibels or vice versa. Suppose you want to convert a voltage ratio of 7:1 to decibels. Simply locate 7 on the inner $\mu\text{V/m}$ scale and follow the hori-

*When converting from
signal level units (dBm)
to field intensity units
(dBu), add the antenna
factor and add any loss
in dB between the
antenna and receiver
input.*

zontal grid to the inner dBu scale at about 17.

Convert decibels to voltage ratios by doing the reverse. Find the decibel figure on the dBu scale and follow the horizontal grid to the $\mu\text{V/m}$ scale to find the equivalent voltage ratio. For example: 20dB corresponds to a voltage ratio of 10:1.

It is easy to find levels such as "15dB above $3\mu\text{V}$." Locate 3 on the inner $\mu\text{V/m}$ scale, and follow the horizontal grid to the 9.5 on the inner dBu scale. Then follow the

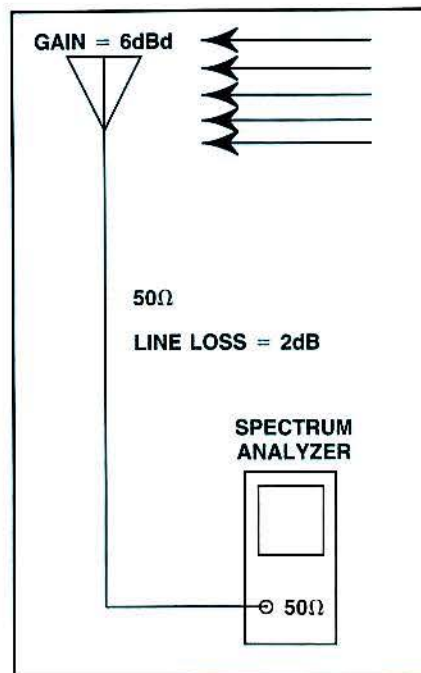


Figure 5. A 50Ω antenna system with a gain of 6dBd is used in conjunction with a spectrum analyzer to measure field intensity.

vertical grid up 15dB to 24.5dBu and, once again, the horizontal grid to about $17\mu\text{V}$.

Remember, when converting from *field intensity units* (dBu) to signal level units (dBm), subtract the antenna factor. Also subtract any loss (such as line loss) between the antenna and receiver input.

When converting from *signal level units* (dBm) to *field intensity units* (dBu), add the antenna factor and add any loss in dB between the antenna and receiver input. Be sure to add and subtract *algebraically*. (Observe the positive and negative signs.)

I hope that this information will assist you in converting between field intensity units and receiver input signal levels. Next month, all the formulas for calculating signal levels, field intensity and antenna factors will be provided, along with typical examples.

As mentioned, the graphs in this article are analogs for a computer program that calculates the precise values. The program, for IBM-compatible computers, is available from the author on a 5.25-inch floppy disk for \$5 plus \$1.50 for shipping and handling. The program is also available on a 3.5-inch floppy disk for 50 cents more. This program does all the conversions discussed in this column quickly, painlessly and more accurately. Write to the author at 204 Tanglewylde Drive, Spartanburg, SC 29301-2949.



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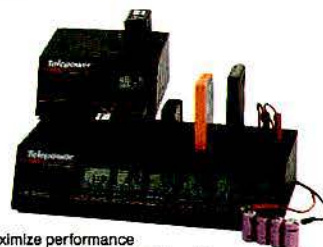
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JBRO Batteries S.W., Inc. 25700 1-45 North #111 Spring, TX 77386 Phone: 713/367-9393 Fax: 713/292-7139 Order Entry: 800/245-1138

Visit Us at IWCE, Booth #475.

Circle (26) on Fast Fact Card

IWCE/Spring show preview/guide

Welcome to *Mobile Radio Technology's* preshow coverage of the **1994 International Wireless Communications Expo/Spring**. Our editors have worked to provide a comprehensive overview of this annual mobile communications show. This section is designed to help you to plan your time at the show at the Las Vegas Convention Center, Las Vegas, April 13-15. Sections include:

- a pull-out map on page 32A, including a list of exhibitors and their booth numbers.
- a summary of exhibitors' products and services on display. Exhibitors listed include those who submitted information as of press time.

More than 300 mobile communications equipment manufacturers, distributors and service providers will convene at the Las Vegas Convention Center, and many exhibitors will debut new products and services as they gear up for 1994. Products on display will include antennas, accessories, cel-

lular items, data communications, mobile and portable radios, paging equipment, test equipment, tone signaling equipment, towers and other wireless-related items.

For a rundown on what exhibitors plan to unveil and showcase at this Spring's Expo, refer to the **Products and Services** section beginning on page 33. The names of

exhibitors who are also advertisers in this issue are **highlighted in blue ink**. Page numbers where you can find their respective advertising are also listed.

In addition to the new products that exhibitors will display individually, there will be a "New Products Information Center" where visitors may review new products and new products literature. Symposia at Expo will cover mobiles communications industry opportunities and technical topics (*see below*).

Mobile Radio Technology will be in booths 373 and 375. See you at Expo!



TENTATIVE IWCE SYMPOSIA SCHEDULE

WEDNESDAY, APRIL 13

- Opening session: "The Wireless Lane on the Information Highway" (8:30 a.m. to 10 a.m.)
- "220MHz Modulation Techniques"
- "Wireless Applications in Public Safety"
- "Mobile Data Networks for End-users"
- "Systems Design for Digital SMR"
- "Mobile Data Applications"
- "220MHz Equipment Overview"

THURSDAY, APRIL 14

- "Capitol Hill Roundtable"
- "Mobile Communications Opportunities Forum: Latin America; Asia; Eastern Europe; Commonwealth of Independent States; Africa; Canada"
- "New Advances in Test Equipment"
- "National Information Infrastructure"
- "Regulatory Parity"
- "PCS Update"
- "FCC Open Roundtable"

FRIDAY, APRIL 15

- "North American Free Trade Agreement"
- "Site Measurement"
- Closing Session: "The EMF Scare" (10:30 a.m. to 11:45 a.m.)

Event: International Wireless Communications Expo
Dates: April 13-15
Location: Las Vegas Convention Center
City: Las Vegas
Number of Exhibitors: More than 300

Projected Attendance: 5,000 to 8,000
Exhibit Hours: Wednesday, April 13, 10 a.m. to 6 p.m.
 Thursday, April 14, 9 a.m. to 6 p.m.
 Friday, April 15, 9 a.m. to 2 p.m.
Registration/Hotel Information: 800-828-0420

Products, services

Information for listings and booth numbers is accurate as of press time and is printed as provided. It is subject to change.

Advance Label & Tag Booths 154, 156

Existing products
Customized logo labels for pagers, cellular and radio equipment; specialized labeling for cap-codes, frequencies; battery warranty and other variable information; bar-code labels; software; printing equipment.
Circle (250) **See classified ads**

Aerotron-Repro Sales Booths 557, 559

Existing products
MPAC base stations and repeaters; NLR-96 spread-spectrum RF modem; SLR-96 RF modem; utility data system; utility repeater.
New products
AER 3000 digital switch; Vista mobiles and portables.
Circle (251)

Air Comm Booth 558

Existing products
Used and reconditioned Motorola, GE, E. F. Johnson and other mobiles, portables, base stations, accessories; PL and Quik Call II paging feeds and filters.
Circle (252) **See classified ads**

Allen Telecom Group Booth 218

Existing products
A/S Mobile Division: vehicular and portable antennas for land mobile and cellular use; Decibel Products Division: metal, fiberglass, panel and Varitilt base station antennas plus site equipment, filters and remote digital site monitors; Grayson Electronics Division: paging repeaters and data trackers.
New products
A/S Mobile Division: On-glass IV with its solid-state coupling box; Decibel Products Division: Sentry remote site monitor with updated software; Grayson Electronics Division: Pagethru 900MHz paging repeater and Pagetracker Enhancement options.
Circle (253) **See ad pages IFC, 29**

Circle (253) **See ad pages IFC, 29**

Allgon Mobile Booth 378

Existing products
Mobile, marine, portable and yagi antennas from 50MHz to 1,800MHz.
New products
Mobile Base 2000 for cellular and PCN.
Circle (254)

American Tower Services Booth 158

Existing products
Erection of guyed and self-supporting towers in rugged terrain access locations.
Circle (255)

Anchor Graphics

Booths 575, 577

Existing products
Labels for cellular phones, overlays, escutcheons, ID tags, serialized and bar codes; labels for pagers, two-way radios; all types of custom labels.
Circle (256) **See classified ads**

Andrew

Booth 1162

Existing products
Heliac coaxial cable product line.

New products
4 1/2" IEC connectors for Heliac cables that meet specs IEC-339-105-3; Valuflex Heliac jumper cable assemblies that are engineered to outperform braided cable assemblies; 3M Cold Shrink weatherproofing kits that do not require heat gun or other tools to install; 1/8" Heliac superflexible cables; PVC jacketing option for 1/2" and smaller Heliac cables that meet NEC CATVX rating; Arrestor Plus surge protector.
Circle (257) **See ad page 39**

Antennas America

Booth not assigned

Existing products
Disguised decal antennas for two-way radio, cellular and other frequencies.
New products
GPS antenna.
Circle (258)

APREL

Booth 143

Existing products
ISO 9000 (Guide 25) accredited independent product evaluation and certification services for radio, cellular, antennas, paging, telecom; R & D, engineering and consulting services in the fields

For more information on the products and services listed, fill out and return the Fast Fact Card on page 113. See example below.

FAST FACT CARD	
1. Name of company	2. Address
3. Phone	4. Fax
5. E-mail	6. Website
7. Booth number	8. Product/Service
9. Description of product/service	10. Price range
11. Applications	12. Other information

XYZ Corporation

Booth 9999

Existing products
Galaxywide paging, satellite rental, multilingual billing formats.
New products
Con-size pagers. This unit operates on ambient heat and needs no batteries.
Circle 900 **See ad page 599**

of electromagnetics/RF, grounding, shielding, 25D, transients, acoustics and electroacoustics performance, network and communications standards.

New products

RADHAZ/EMF research, testing and consulting; information security (INFOSEC) consulting and system design.
Circle (259)

Astron

Booths 1250, 1252

Existing products
Power supplies; inverters; converters.
Circle (260) **See ad page 41**

Avcom of Virginia

Booth 1275

Existing products
Models PSA-65A, PSA-37D, PSA-35A portable spectrum analyzers; NASA-1000A network and spectrum analyzers; models MSC-1000B, MSG-170A; MSG-5 microwave sweep generators; Inmarsat, SCPC, SCS, video, test satellite receivers; microwave accessories.
New products
BNG-1000A broadband noise generator for use with spectrum analyzers to allow them to do swept measurements similar to that of a tracking generator; CAE-1575 GPS antenna extension for operating GPS receivers in the vehicle.
Circle (261)

Avtec

Booths 1257, 1259

Existing products
Color touchscreen-operated, integrated radiotelephone dispatch console systems for control of conventional radio, trunked radio, PBX lines, CO lines, ringdown lines with paging, autodial and many other features.
New products
DSPatch digitally switched color touchscreen console system controls from 32 to 1,024 lines or operator positions and has all conventional and trunked radio requirements with advanced telephone features.
Circle (262)

Bally Engineered Structures

Booth 256

Existing products
Lightweight insulated modular panels assembled with a "speed-lok" fastening system to permit on-site construction for remote and roof-top applications.
Circle (263)

Bee Electronics

Booths 363, 365

Existing products
2011B leather case fits Motorola GP300; 7095B leather case fits Kenwood TK480; 961 leather case fits Motorola 8000 cellular phone; 902 leather case fits Bravo Express pager.
New products
2025B leather case fits Motorola HT 1000 and MTX 8000; 5102 leather case fits Ericsson GE Monogram; 964 leather case fits Motorola Micro Tac cellular phone; 976 leather case fits Oki 1150 cellular phone.
Circle (264) **See ad page 70**

RESUME



Name : everReach Pager

Born : Autumn in 1993

Previous Experience :

Highly successful performance in ASIA

Career Goal :

To provide the highest quality pager
to be successful in the United States

Character :

- 1) Provides a full 18 MONTH WARRANTY to users
- 2) High quality and trouble free
- 3) Reasonable price and easy after sales service

Number One Skill :

Catches every signal - Highly sensitive

Features :

Small and light (compact design)
Power back-up
Automatic power on/off
Message protection by a user's password
Time stamping
Duplicate message check
20 message memory
Alarm
Vibration standard
Free Accessories

Contact :

EVERON AMERICA, INC.
836 Foley Street
Jackson, MS 39202
1-800-603-3766

everreach

A close-up of a fountain pen nib, likely a Montblaster Meisterstück, pointing towards the bottom right corner of the page.



***Recommend me to your customers,
and they will be 100% satisfied
with my performance.***

EVERON

AMERICA, INC.

TEL. 800 603-3766 FAX 601 949-3349

Circle (97) on Fast Fact Card

Bendix/King

Booth 134

Existing products

EMV, UHF mobile; LMH, VHF mobile; LPX, 800MHz portable; EPU, UHF portable; EPV, UHF portable.

New products

EMH Flex-Mode VHF mobile—136MHz-174MHz; EPH Flex-Mode 1.5W and 5W VHF portables; EPI, VHF portable.

Circle (265)

Bird Electronic

Booths 563, 565

Existing products

Thurline RF directional wattmeters; Termaline RF load resistors; Tenuline RF attenuators; RF filters; RF couplers; field strength elements; meters; accessories.

New products

AT-800 cellular antenna tester that measures antenna performance in the 806MHz-960MHz range.

Circle (266)

Bomar Crystal

Booths 232, 234

Existing products

Motorola Bravo pager crystals for all bands; GE MVP mobile crystals and channel elements; Motorola MT500 crystals and channel elements.

New products

Motorola Bravo Plus pager crystals for all bands; Motorola Advisor pager crystals for 900MHz; Fanon Courier M54, MU54 land mobile crystals.

Circle (267)

See ad page 82

Bramco

Booth 238

Existing products

Tower light monitor; mobile message center; mobile encoders; mobile decoders; ANI systems; tone system; reeds and active filters; eight-function controller.

New products

Model 3065 micro ANI encoder; model 3063 micro mobile decoder.

Circle (268)

See classified ads

Cadex Electronics

Booth 773

Existing products

C-series programmable battery analyzers; more than 500 battery-specific "smart" adapters are available.

Circle (269)

Cajun Tower Systems

Booth 1173

Existing products

Self-supporting and guyed communication towers.

Circle (270)

Carlson Communications—see listing under Optaphone Systems

Cartwright Communications Booths 262, 264

Existing products

Transmitter combiners, receiver multicouplers, isolators, duplexers and other site management products from Antenna Specialists, Celwave, Decibel Products and Telewave; demonstration

of how combiners are tuned using a Hewlett-Packard network analyzer.

Circle (271)

Cellular & Mobile International

Booths 373, 375

Existing products

Mobile Radio Technology and Cellular Business magazines jointly publish this bi-monthly magazine for the international marketplace. The publication, *Cellular & Mobile International*, focuses on key issues and developments pertinent to the mobile RF environment. The circulation of 10,000 predominantly reaches Africa, Australia, Central America, Europe, Far East, Middle East, New Zealand and South America.

Circle (272)

Cellular Business

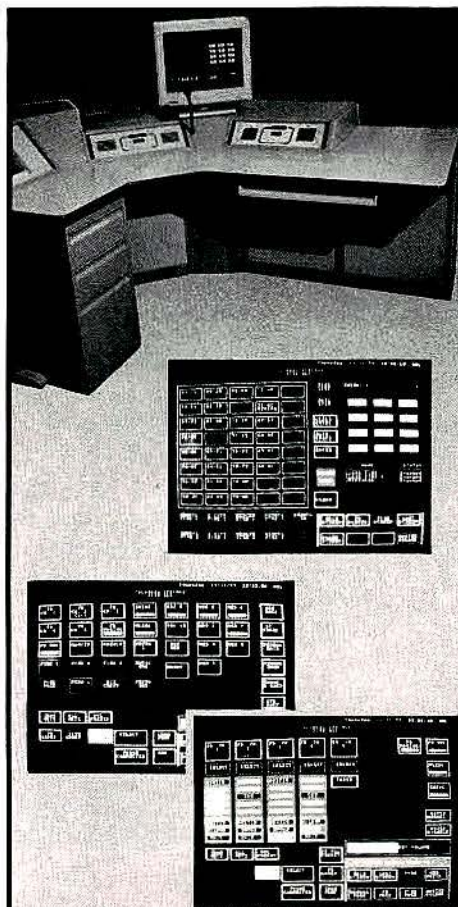
Booths 373, 375

Existing products

Cellular Business is the "Journal of Cellular Telecommunications." It is published monthly and provides marketing and engineering information and news of the cellular industry. Readers are cellular professionals, including system operators; dealers; retailers; agents; resellers; engineers; and members of the telecommunications financial and legal communities.

New products

Calling All Carriers provides the industry's most complete directory of cellular carriers with addresses, telephone numbers, fax numbers, and related switch and cell-site information. The



Our Dispatcher Workstations Work the Way You Work

Moducom Ultra-Com PRO and DT communications workstations, whether stand-alone or as part of multi-position consoles, let you program and modify your complete system to reflect your operating requirements.

Only Moducom's proprietary "Screenmaker" and "Customizer" programs give you this unique control, designed specifically for your needs and preferences. You can quickly and easily design operating screens for function, color, switch sizes and locations, and more.

Ultra-Com communications control systems offer more features, more control and unparalleled flexibility.

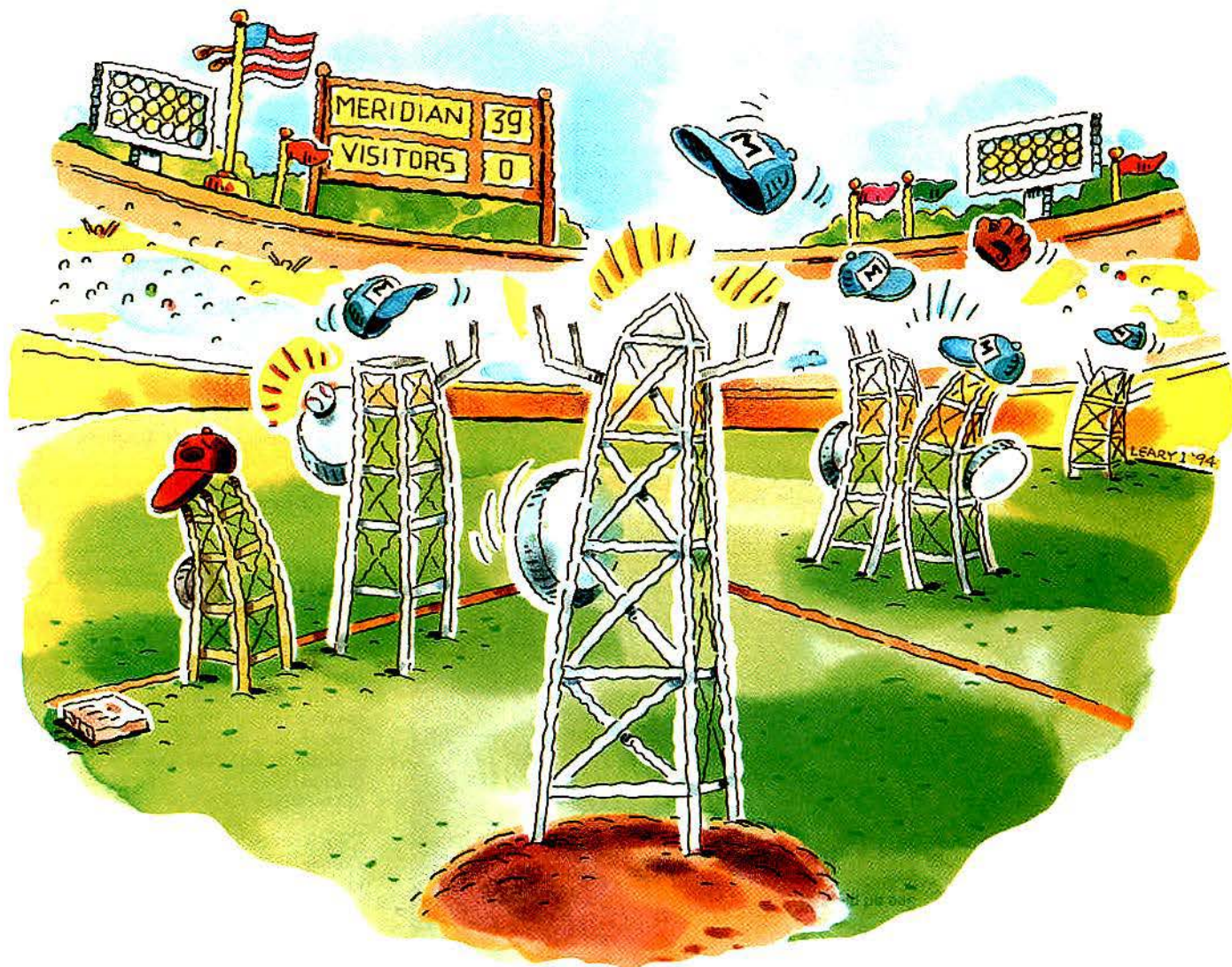
Moducom consoles and workstations are designed for today's emergency communications requirements and budgets.

Moducom works the way you work. Call or write for our literature package and free programming demo disk.

MODULAR COMMUNICATION SYSTEMS, INC.

13309 Saticoy St., No. Hollywood, CA 91605

(818) 764-1333 • FAX: (818) 764-1992



We have major league experience.

Here's our pitch. When you're looking for antenna site space in Southern California, don't waste your time with minor leaguers. Meridian's team brings you over 38 years experience, plus a lineup of 39 sites with coverage that stretches from the Mexican border to Santa Maria. Our newest site is a rookie named Banning Peak which covers Banning Pass.

As Southern California's MVP, Meridian is a seasoned pro with state-of-the-art facilities. We're currently initiating continuous site monitoring to keep score of the temperature, electricity status and other variables. If something goes foul, we'll know!

And we're batting a thousand when it comes to stand-by power, air conditioning, and site maintenance. We also have a new high-security access system on deck for 1994.

Best of all, you'll get the personal touch of both our owner and our coach, Jack and Rich Reichler. Call us toll free at (800) 400-SITE. And see why our fans think we're all stars. **Great sites, great service, since 1956.**



Meridian Communications

23501 Park Sorrento, Suite 213A, Calabasas, CA 91302-1355
(818) 888-7000 • (800) 400-SITE (7483) • Fax (818) 888-2857

guide is updated quarterly so that you will have the latest available information about carriers.
Circle (273)

Cellular Wholesalers Booths 442, 444

Existing products
Cellular phones manufactured by Motorola, NEC, Oki, Blaupunkt, Audiovox, Technophone, Pioneer, Fujitsu; two-way radios manufactured by Motorola Spirit, Ranger and Maxon.
Circle (274)

Celwave

Existing products
Mobile telecommunications systems products, including base antennas, transmitter combiners, receiver multicouplers, filters, duplexers, bidirectional amplifiers, transmission line products.
New products

Distributed antenna system products; Great Seal cold shrink; WJD860 waveguide combiner.
Circle (275) See ad page 19

Booth 434

Central Tower

Booth 1271

Existing products
SSX towers; SRX towers; self-supporting towers and tower accessories.
New products
Central Tower universal sidearms.
Circle (276)

Centurion International Booths 357, 359, 361

Existing products
Cellular, wireless, GSM, PCN and PCS antennas; land mobile antennas and batteries.
New products
Injection-molded 5 1/2" CXPS antenna with 2.5dBi gain, 1/2-wave; EXP antenna with 2.5dBi gain.
Circle (277) See ad page 9

Childs Antennas

Booth not assigned

Existing products
Land mobile and cellular antennas; land mobile and cellular mount kits; base antennas; portable antennas.
New products
Ultra Stick base antenna.
Circle (278)

Cimarron Technologies

Booths 779, 781

Existing products
GE-STAR compatible line of ANI products; C-Mark series of desktop display and computer interface units; subminiature encoder and decoder line for mobiles and portables. All products include Man Down and emergency functions.
Circle (279) See ad page 25

CML Technologies

Booth 1373

Existing products
Liberty radio and E9-1-1 dispatch console.
New products
CRT-based touchscreen radio console.
Circle (280) See ad page 77

Comm-Net 2000

Booth not assigned

Existing products
DG 200 radio delay timer; DGRM 501 and 501B repeater and crossband repeater; DGME 1000 mobile extender.
Circle (281) See classified ads

Communications Associates

Booths 658, 660, 662

Existing products
Wholesale distributor of more than 70 communications product lines, including lightning protection, cellular phones and accessories, cell site antennas and cable, portable fax machines and test equipment.
Circle (282) See classified ads

Communications Data Services

Booth 1557

Existing products
RFCAD, RFPATH, TProfile.
New Products
RFCAD I.2.
Circle (283) See classified ads

Communications Specialists

Booth 522

Existing products
TS-32P series CTCSS encoder-decoder; SS-32P and SS-32SMP series CTCSS and burst tone

CHECKMATE IV
THE NEXT GENERATION

Providing Tone and Voice Pagers for over twenty years.

FEATURES:

- Choice of Reed or Programmable Decoder
- Reed - High Sensitivity
- Programmable - Increased Option Features
- Rugged Black or Red Case
- Small Size - 3 1/8" x 2 7/16" x 15/16"
- Single "AA" Battery
- Variable Volume Control
- Group Call Standard on Second Tone
- Channel Monitoring Capability
- 3 Year Limited Warranty Standard
- 4 & 5 Year Limited Warranty Available

SHINWA Communications of America Inc.
P.O. Box 26407
Oklahoma City, OK 73126
TEL 1-800-627-4722
FAX 1-800-759-1722

SHINWA Tsushinki Co., Ltd.
12-2 Hamadayama 4-Chome
Suginami-Ku Tokyo, Japan
TEL (03) 3313-1211
FAX (03) 3313-1218
TELEX: J27432 Slnwacom

Circle (32) on Fast Fact Card

HELIAX®

No Assembly Required

When you're looking for the highest performing, most cost-effective cable assembly in the business, look to Andrew to deliver. That's because only Andrew designs, manufactures, assembles and pretests HELIAX coaxial cable and premium connectors to insure that they're ready to work, right out of the box.

Pre-fabricated HELIAX cable assemblies not only save you valuable time in the field, they're designed to optimize the performance of your system. Now backed by a new three-year extended warranty, ready-to-install HELIAX cable assemblies offer:

- Low attenuation
- Low VSWR
- Low intermodulation
- Indoor or outdoor applications
- High shielding effectiveness
- High flexibility
- High average power

For superior performance,
"Ask for HELIAX" cable
assemblies today!



ANDREW

10500 W. 153rd Street
Orland Park, IL 60462 U.S.A.

For complete details, call our Customer Support Center
at 1-800-255-1479 Ext.12, or fax us at 1-800-349-5444.

HELIAX® Cable... The Global Leader in Cellular Communications

Circle (33) on Fast Fact Card

Andrew
designs,
manufactures,



assembles
and pretests
HELIAX
coaxial cable



and premium
connectors.

F6-50 HELIAX®

Expo

encoders; SD-1000 and PE-2P series two-tone sequential encoder and decoder; PE-1000 series paging encoder; PE-4/PE-15 series POCSAG (RPC1) paging encoders; TP-38 repeater tone panel; DTD-1 DTMF decoder; DCS-23 DCS encoder-decoder; TS-64 CTCSS encoder-decoder; ID-8 Morse code station identifier.
Circle (284) **See ad BC**

Computer Resources **Booths 1366, 1368**
Existing products
 Turnkey systems for the two-way radio industry;

service and sales management; SMR billing; pager billing and inventory; associated accounting modules.
Circle (285) **See classified ads**

Comsearch **Booths 1244, 1246**
Existing products
 Engineering software products and services that support the design, optimization and implementation of wireless communications systems of any type.
Circle (431)

Comtelco Industries **Booth 273**
Existing products
 Omnidirectional and yagi base station antennas; lowband, highband, UHF, 800MHz and 900MHz, 1GHz-and-above mobile antennas; special purpose antennas.

New products
 1GHz-and-above antennas.
Circle (286) **See ad page 62**

Connect Systems **Booth 766**
Existing products
 TP-154 tone panel; CS-800 interconnect; CS-900, 6800, 8200, 9800, CS-700 interconnects; CD-1 communications tone/DCS/DTMF decoder and display unit; RT8 rural telephone system.
New products
 EX-8 line expander module; TP-154 Plus repeater, tone panel and interconnect in one unit.
Circle (287) **See ad page 13**

CPI Communications **Booths 966 and 968**
Existing products
 Dc remotes and termination panels; tone remotes and termination panels; local extensions; signaling products.
New products
 DTP series dc panels; newly designed and packaged tone remotes; MCR310 multi-channel remote for Midland XTR; TSR200 multi-system and subfleet remote for Motorola Maxtrac 800 trunking.
Circle (288) **See ad page 66**

CTI **Booth 1150**
Existing products
 Page Master Phase II; Mobile Master Phase II; Mittec-Page (alphanumeric); Mittec-Page (analog/digital); WEE-Page; SF-65 page store and forward unit; TXC-100/200 remote base station controller; DID/SMR 3-5.
New products
 SX-96 multi-port trunk controller; Opti-Page voice mail/paging terminal; TNPP paging network controller.
Circle (289)

Cushcraft/Signals **Booth 128**
Existing products
 Many antennas for a broad range of data collection and land mobile applications.
New products
 S9026P 902MHz patch; S2406P 2.4GHz patch; S2400B unity gain 2.4GHz omni; S2403B, 3dB 2.4GHz omni.
Circle (290) **See ad page 15**

Cushman/ KNS Enterprises **Booth 1445**
Existing products
 Models 7120, 7130, 6030 communications monitors.
New products
 KNS model K-300 spectrum monitor; KNS model K-30 selective level meter.
Circle (291)

D & L Two-way **Booths 377, 379**
Wholesale Distribution
Existing products
 GE two-way radio mobiles, portables and base stations; repeaters.
New products
 Monogram mobile and portable; EDACS duplex

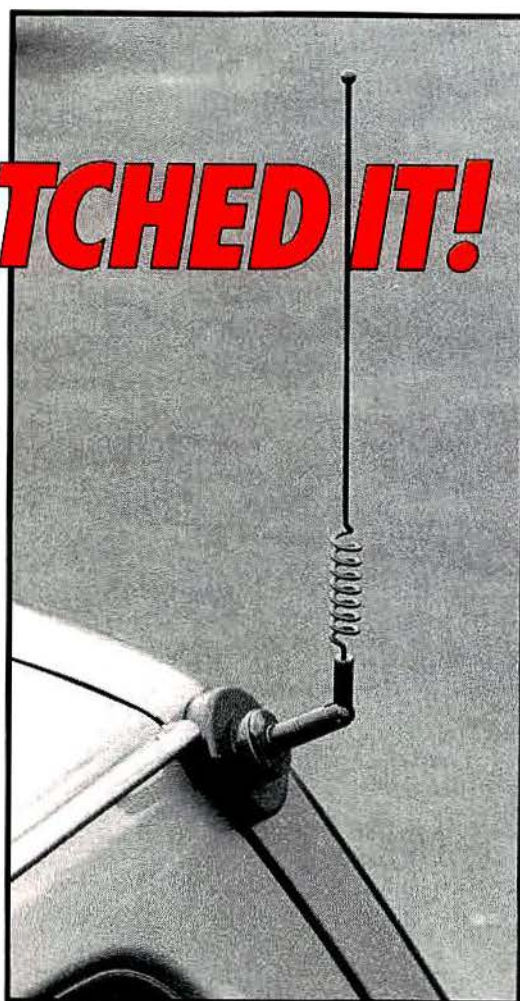
WE HATCHED IT!

A new idea for hatchback vehicles – STI-CO's **Swivel Adaptor!**

Our new option for trunk lip mount cellular look-alike antennas fits most hatchback cars, vans, and 4-wheelers.

Another innovation from...

The
DISGUISE GUYS



11 COBHAM DRIVE ORCHARD PARK, NY 14127-4187 (716) 662-2680 FAX -5150
Circle (34) on Fast Fact Card

POWER ON... with ASTRON.

Astron Corporation is the leading manufacturer of high-quality power supplies and converters for the land mobile industry.

With the new SL-11 series of low profile power supplies, specifically designed for base station applications, the setup is simple, easy and looks attractive. Just mount the radio, with the mounting pads (supplied with the power supply), to the top of the SL-11A (2 3/4" H x 7 5/8" W x 9 3/4" D) or the SL-11R (2 3/4" H x 7" W x 9 3/4" D). The power supplies are very well regulated and will provide 11 amps of current at a 50% duty cycle. The units have fold-back current limiting to protect them from overload and short circuit, and an overvoltage protection feature to protect the radio should the output voltage exceed a safe level. All SL series units are available in dark gray or black.

Power supplies and converters from Astron: our unsurpassed quality and reliability have made us the #1 choice in the communications industry.

ASTRON
CORPORATION

9 Autry, Irvine, CA 92718
Telephone: 714/458-7277
Facsimile: 714/458-0826

ASTRON SL-11A

3A D32A

33

3A D33A

3A D35A

FUJI RDP

33

FUJI RDP

34

35

FUJI RDP

Expo

portable; Orion mobile.

Circle (292) See ad page 30, classifieds

Daniels Electronics Booth 1372

Existing products
VHF, UHF, 800MHz, synthesized portable, transportable and fixed radio systems.

New products

PRP-1 portable radio system.

Circle (293) See ad page 60

DataCom Systems Booth 1565

Existing products
Models 2WFD and 4WFD telephone line extenders, data units; 2WEL economy telephone line extenders; RRC-93 radio remote controllers; DRS-010 radio switches.

Circle (294)

Dataradio Booth 162

Existing products
Vehicular information series (VIS) radio modems including "MRM" series mobile radio modems for conventional and trunked applications.

New products

Mobilmux for integrating GPS sensors terminals and printers in mobile data applications; MSC multi-site controller for wide-area mobile data systems.

Circle (295)

David Clark Booths 659, 661

Existing products
Headsets with push-to-talk adapter cords for

portable and mobile radios; voice-activated headsets for portable radios; headset intercom systems with two-way interface.

New products

Ultra lightweight style headset for mobile radio and intercom system applications.

Circle (296) See ad page 12

Dinet—Distributed Networks Booth not assigned

Existing products
DataMate 1000, 1500, 3100 mobile terminal system; Unipage II-20 paging encoder; DVA 1000 digital voice announcer.

New products

DataMate AVL/GPS location system.

Circle (297)

Dynatech Tactical Communications (DTC) Booths 815, 817

Existing products
RHS series radio headsets, PTT and vox; EM series ear microphones, TM series throat microphones; SK series security kits; wireless earphones.

New products

RHS-4 dual earpad lightweight headset.

Circle (298) See ad page 84

DX Radio Systems Booths 831, 833

Existing products
Repeaters; base stations; paging transmitters; telephone links.

New products

DXP-6000 simulcast paging transmitters.

Circle (299) See ad page 55

EDX Engineering Booths 278, 280

Existing products

CVR v.1.1; POP-90 v. 2.0; TERRN v. 4.1.

New products

MCSX v. 2.0; SIGNAL v. 2.0; MSITE v. 6.0;

SHDMP v. 6.0; TPATH v. 2.0; RPATH v. 7.0.

Circle (300)

E. F. Johnson Booth 502

Existing products

Complete LTR system including 8600 series mobiles and 8500 series hand-helds; conventional products including Challenger mobiles and model 5876 hand-helds; complete line of American Networking products.

New products

Avenger family of mobiles and hand-helds; Viking GT and Viking HT mobiles; Viking VX repeater; Viking network solutions.

Circle (301)

Electro Dynamics Crystal Booth 1583

Existing products

Crystals—LMR and pager.

Circle (302) See classified ads

EMR Booths 1175, 1177, 1179

Existing products

Isolators; load terminations; cavity resonators;

art 88 compliant—today!

WHEN TRAGEDY STRIKES, LACK OF COMMUNICATION IS A REAL DISASTER



Whether it's co-ordinating Search and Rescue teams or dealing with ground relief support groups, a portable communications system is an absolute priority in times of emergency.

The Tait Portable Repeater Station has been designed to be put into action immediately, effectively. Light, robust and 'showerproof', the Portable Repeater Station can handle a network of mobile and handheld radio transmissions in the most remote of terrain.

Wherever life is in danger, the Tait Portable Repeater Station brings the promise of help.

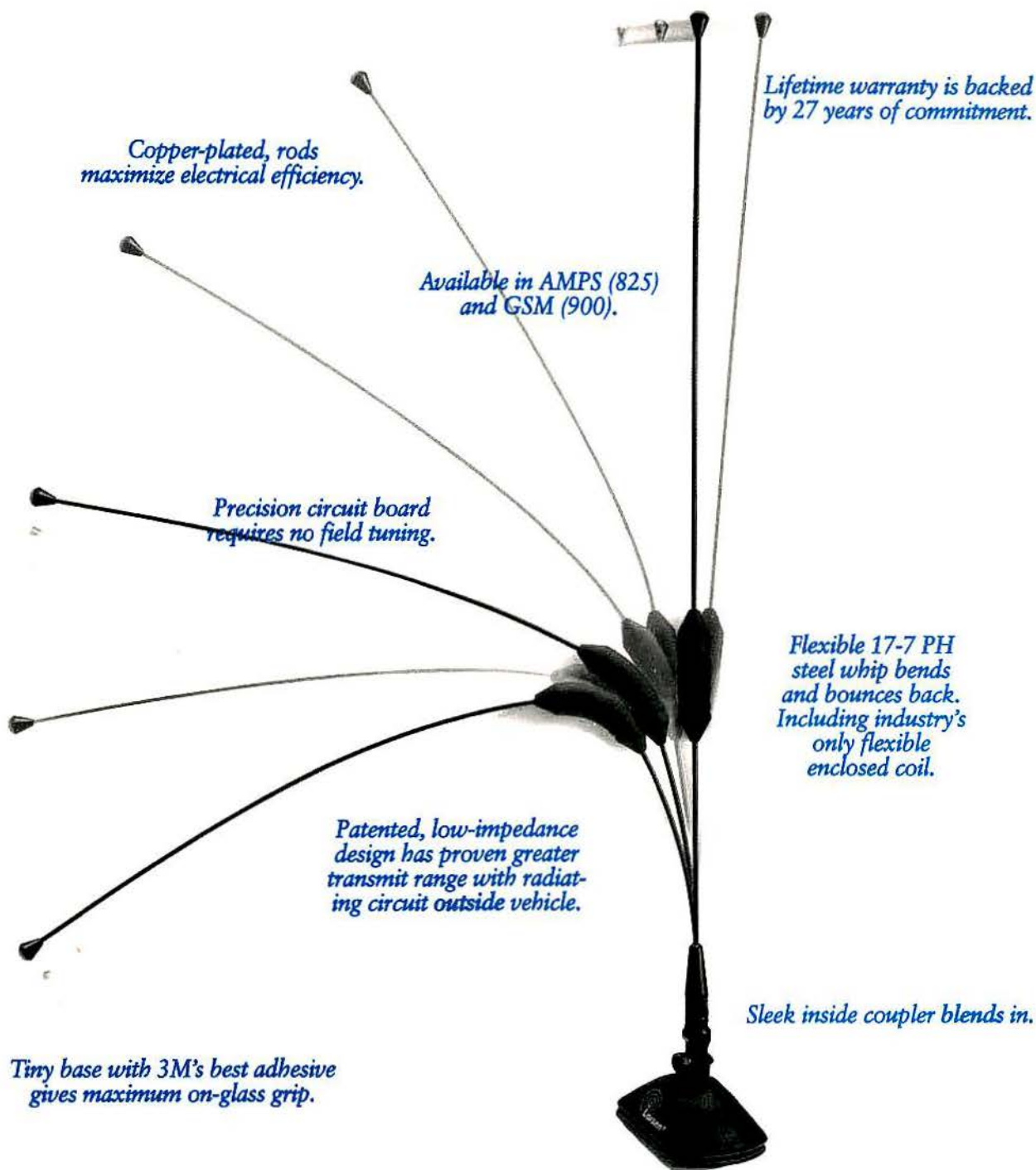


Tait Electronics U.S.A. Inc.

9434 Old Katy Road, Suite 13
Houston, Texas 77055, USA Phone (713) 984-8666
Outside Texas 800 222-3254 Fax (713) 468-6700

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Circle (36) on Fast Fact Card



Tiny base with 3M's best adhesive gives maximum on-glass grip.

No Other On-Glass Antenna Stands Up To Larsen.



For on-glass antennas, Larsen's state-of-the-art features set industry standards. They maximize cell system performance. Increase voice quality. Prevent

dropped calls. And of course, make happy subscribers.

So call 800-426-1656 or fax 206-944-7556.



Larsen Antennas®
The Clear Choice™

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antenna duplexers; receiver multicouplers; transmitter combiners.
New products _____
 60000/EH series economical base station duplexers; 26000/TTT tubular format tovertop SMR receiver multicouplers; 26000/BDA and 26000/UDA bidirectional and unidirectional SMR enhancement systems; 6454/VBB VHF-band crystal-cav.
Circle (303)

Engineered Endeavors **Booth 486**
Existing products _____
 Monopoles, rotatable platforms; ancillary equipment; installation services.
Circle (304)

Epcom **Booth 1660**
Existing products _____
 Two-way radio equipment and accessories.
Circle (305)

Ericsson GE **Booth 302**
Mobile Communications
Existing products _____
 Enhanced Digital Access Communication System (EDACS) and products including M-RK, PCS; MPA portable radios and MDX, MDR and Orion mobiles.
New products _____
 EDACS Duplex portable; MASTR III 800MHz; MDX conventional mobile; TMX 8810 trunked mobile; M-RK vehicular charger.
Circle (306) **See ad page 49**

ETrunk Systems **Booth 480**
Existing products _____
 ETrunk Ultra boards; controllers; hand-held and mobile radios.
New products _____
 ETR500 synthesized repeaters; ETR1000 repeater panel.
Circle (307) **See classified ads**

Everon America **Booth 1348**
Existing products _____
 Everreach EP-110 digital display pager; Everreach EP-910 digital display pager; ECL-2000 900MHz cordless phone.
Circle (308) **See ad page 34-35**

Falcon Tower Fabricators **Booth 677**
Existing products _____
 Guyed and self-supporting tower structures; flanged and polygonal monopoles; custom fabricated mounts; specialty items.
New products _____
 Structural and civil engineering services.
Circle (309)

Fanon Courier **Booths 1256, 1258**
Existing products _____
 Courier Procom 2 x 1 and Procom 2 x 2 two-watt VHF portable FM transceiver; Procom U22 two-watt, two-channel UHF portable FM transceivers; Procom M54 and MU54 five-watt, four-channel miniature VHF and UHF portable FM transceivers; Fanon megaphones; intercoms;

public address amplifiers; paging and talkback speakers.
Circle (310) **See classified ads**

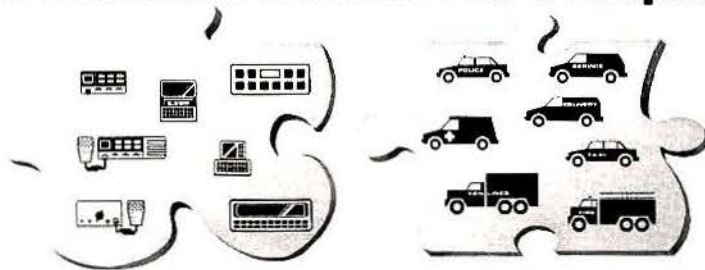
Fibrebond **Booth 1173**
Existing products _____
 GFRC, solid concrete, metal and exportable communication shelters.
New products _____
 Cell on wheels featuring an 85-foot monopole.
Circle (311)

Flash Technology Corporation of America **Booth not assigned**
Existing products _____
 Electroflash FTB 310 medium intensity obstruction lighting system.
New products _____
 Electroflash FTB 311 medium intensity obstruction lighting system with red system controller.
Circle (312)

Freeman Engineering Associates **Booths 1342, 1443**
Existing products _____
 PVM series paging and voice services terminal products
Circle (313)

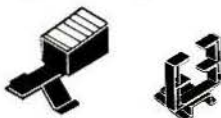
Gamber-Johnson **Booth 452**
Existing products _____
 MissionControl complete mounting system; FloorMaster; DS series air bag-friendly bases and

Matchable Solutions For Your Mobile Communications Requirements



Whatever voice/data mobile communications equipment you want to mount...

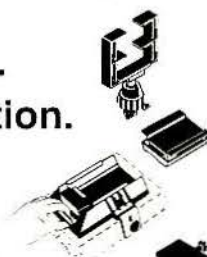
Whatever vehicles you want to mount it in...
 You need the right hardware to fit your application.



For literature on the right hardware NOW
 Call 1-800-GJ-MOUNT (1-800-456-6868)
 Fax 1-800-WE-HELPP (1-800-934-3577)

GAMBER-JOHNSON
 Service & Solutions™

801 Francis Street, Stevens Point, Wisconsin 54481



Nothing cuts through test and troubleshooting problems faster than the HP 8920A service monitor.



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From benchtop to mountain top, the HP 8920A provides you with fast, easy and repeatable results.

To keep a communications system running you have to get through test and troubleshooting fast. The HP 8920A gives you the capability to keep problems from mounting up.

It has a built-in spectrum analyzer and tracking generator with markers for quickly finding signals. And 1 dB, 2 dB, and 10 dB amplitude resolution for tuning duplexers and filters.

Built-in encode/decode capabilities like POCSAG, GOLAY, AMPS, NAMPS, TACS, NTACS, and NMT

put paging and cellular tests right at your fingertips. You also get E.F. Johnson and E.G.E. trunking for the most signaling available in a service monitor. Along with save/recall, auto-tuning, and auto-print functions that make it easy to get fast, accurate results.

Add to all this, easy-to-use software with repeatable, documented testing for spotting problems quickly in mobile, trunked and cellular radios, and AMPS base stations. And you can see why the HP 8920A helps you solve problems faster.

So if you want to cut through test and troubleshooting, call **1-800-452-4844**. Ask for **Ext. 3204** and

we'll send you a video and a brochure that explain how the HP 8920A service monitor gives you the edge you need.

New for HP 8920A

HP 8920D for TDMA digital phone test
HP 8921A/D for cell-site test
Improved residual FM
Low-level RF power test

There is a better way



CLEARCHANNEL LTR is a registered trademark of E.F. Johnson Company. EDACS is a registered trademark of Ericsson G.E. Mobile Communications, Incorporated.

Expo

mount heads; SuperSlide.

New products

DS-16 Ford Explorer base; GRiD convertible locking mount; DS-Pad docking station for GRiD pad.

Circle (314)

See ad page 44

General Communications

Booth 1061

Existing products

General Electric mobile communications products; Midland mobile communications products.

Circle (315)

See classified ads

GLB Electronics

Booth 575

Existing products

RDC (radio data controller); SNRDS (synthesized netlink radio data system).

New products

Enhanced, reduced-size modem—19.2 on 25kHz channels, 9.6 on 12.5kHz channels.

Circle (316)

See ad page 86

Glenayre Electronics

Booth 618

Existing products

MVP-E modular voice processing system; GL-3000EX paging terminal; GL-T8600 transmitter; GL-C2000 controller; GL-S2164 Wegener satellite receiver; GL-T8500 transmitter; GL-5310 VHF paging transmitter; GL-1205 radiotelephone switch.

New products

GL-T8600 transmitter with GL-C2000 controller; GL-E5310 VHF paging transmitter.

Circle (317)

Hark Systems

Booth 1056

Existing products

Mega Switch 256-port digital/analog switch; TAP200 alphanumeric concentrator; Verifier paging decoder; CD100 click detector.

New products

PC TAP controller for alpha paging concentration and renting.

Circle (318)

Helper Instruments

Booths 1447, 1449

Existing products

Complete line of Sinadders; SM-1000 service monitor; MB-800 matchbox; MB-500 matchbox; RF-801 millivoltmeter; LM-106 lineman; PS-250 precision power supply; DSR-100 digital squelch reader; T-203 Toner III.

Circle (319)

Henry Radio

Booth not assigned

Existing products

Henry RF amps; Bird wattmeters; Radius handhelds.

Circle (322)

See ad page 80, classifieds

Hewlett-Packard

Booth 1266

Existing products

HP8920A RF Communications test set; HP 8920D dual-mode cellular mobile test system; HP8921A1D dual-mode cell site test system; HP 8594A spectrum analyzer with 85718B NADC-TDMA measurement personality.

New products

HP 8648 AIBIC signal generator.

Circle (320)

See ad page 45

Richard Hirschmann of America

Booths 1473, 1475

Existing products

NMO series land mobile and cellular antennas; panel and corner reflector base station antennas; MCA 2000 and ON-2b cellular antennas.

New products

NMO series shielded antenna mount; NMO ¾" mobile antenna.

Circle (321)

Hughey & Phillips

Booth 970

Existing products

FAA-approved obstruction lighting for tall towers; controllers and monitors.

New products

Flashguard 2000 and Flashguard 3000 series strobe lights FAA L864 and L865.

Circle (323)

Hustler

Booth not assigned

Existing products

Spirit series base antennas; heavy-duty series base antennas; G7 series base antennas; G6 series base antennas.

New products

HPCN series panel antennas for PCS and PCN.

Circle (324)

See ad page 51

THE ONE MOBILE DATA TERMINAL FOR ALL YOUR COMMUNICATIONS NEEDS.



THE NEW DL-40 UNIVERSAL DATA TERMINAL. FIND OUT WHAT IT CAN DO FOR YOUR CUSTOMERS.



Trident Micro Systems

17951 Lyons Circle, Huntington Beach, CA 92647 Ph (714) 549-5206

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800-345-0720 Mid-West Office

Circle (40) on Fast Fact Card



Synthesized, Field Programmable
11 channels
5 Watts VHF/UHF
8 Hr Battery Life,
10 Hr Battery Available
Frequency Bands: 136-174
400-430, 450-512 MHz
Wide Band Operation:
VHF 15MHz/UHF 20 MHz
Scan
Tone Coded Squelch
Digital Coded Squelch
Two-Tone Sequential Decode
Rugged, Uni-Body Housing
Two Year Factory Warranty
Made In USA

VHF \$429 UHF \$449



Synthesized, Field Programmable
16 channels
30 Watts VHF 25 Watts UHF
Frequency Bands: 136-174
400-430, 450-512 MHz
Wide Band Operation:
VHF 15MHz/UHF 20 MHz
Scan
Tone Coded Squelch
Digital Coded Squelch
Two-Tone Sequential Decode
Rugged, Uni-Body Housing
Two Year Factory Warranty
Made In USA

VHF \$469 UHF \$499



*Portable comes with: battery, antenna, wall charger and belt clip.
Optional accessories: DTMF keypad, speaker microphone, earphone
or headset, fast rate drop-in charger and carry holster.*

*Mobile comes with: installation kit, band microphone
and external speaker jack. Optional accessories: DTMF
band microphone and 5 watt external speaker.*

DEAL WITH IT.

The new line of Patriot two-way radios really gives you something to deal with. Not only do you receive the benefits of a premium product line that's built in the USA by Ritron, but a product line with high dealer margins. And even more than that, you get strong dealer

support from the factory. It's true we have Patriot radio dealers worldwide, but right now a limited number of dealerships are still available. So take advantage of a truly patriotic deal, and call us at 1-800-USA-1-USA. FAX: 317-846-4978.

PATRIOT
BY RITRON

Hutton Communications Booths 1057, 1059

Existing products

Products from more than 80 industry manufacturers, including Andrew, Antenna Specialists, Antenna Company, Celwave, Decibel Products, Ora and many others; Hutton product selection guide.

New products

Hutton "mini" cellular catalog; cellular products. **Circle (325)** See ad page 24

Hy-Q International

Booth 675

Existing products

Quartz crystal products for pagers, mobile radios, channel elements and all types of wireless communications equipment. **Circle (432)** See classified ads

I.C.T.

Booth 151

Existing products

24-12 industrial power series (dc-dc); isolated series 24-12, 48-12, 72-12 (dc-dc) power filters, power supplies; 12-12 industrial power series (dc-dc). **Circle (326)** See ad page 85

ICOM America

Booth 114

Existing products

Land mobile communications equipment, including UHF and VHF mobiles and portables, base stations, repeaters, and general coverage receivers; avionics equipment. **Circle (327)**

IDA

Booths 255, 257, 259

Existing products

V-series DTMF mics; 40 series interconnects; 24 series tone and dc remotes; RLC logic tray; 5.0 billing software; System 3 billing package; Easy-Link Plus; Net-Link; 20 series remote panels; DID 1200.

New products

VS-1 scrambler; VS-1P scrambler; VS-3 scrambler; Airwave Commander fleet management; 40-30 interconnect; DHB digital hybrid; LTI trunking interconnect. **Circle (328)**

IFR Systems

Booths 759, 761, 763

Existing products

FM/AM-500A, 1200 Super S, Com-120A, FM/AM-1600S service monitors and the AN-920, AN-930, AN-940 spectrum analyzers. **Circle (329)** See ad page 53

Industrial Telecommunications Association (ITA)

Booth 471

Existing products

Frequency availability analyses; coordination; licensing; application engineering; membership services for PLMRS, MAS and microwave applicants; 220MHz and 800MHz/900MHz license data and research; publication of Telecom Exchange, a monthly news magazine; parts 90 and 17. **Circle (330)**

Interactive Systems

Booth 1456

Existing products

Interactive access to FCC licensee data. Products: PCS, SMR, PCP, RCC, cellular, microwave, Parts 90/95/22 etc. Radius searches, regions, states, nationwide—updated nightly; search for licensees, frequency ranges, towers, airports, wait lists.

New products

Electronic update service by broadcast fax, E-mail, direct dial. **Circle (331)** See ad page 83

International Crystal Mfg. (ICM) Booth 127

Existing products

Crystals; channel elements; TCXOs; VCXOs; radios; pagers. **Circle (332)** See ad page 71, classifieds

JB Communications

Booth 1174

Existing products

Cellular cable assemblies; antennas; mounts; connectors; batteries; chargers; cases; accessories.

New products

Glass-mount unity gain antenna; Quick Release CD holder; portable phone holder with charger. **Circle (333)**

JBro Batteries

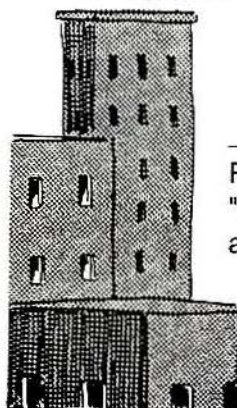
Booth 475

Existing products

JBro replacement battery line for two-way ra-

FOR RADIO COMMUNICATIONS

THE BEST CHOICE

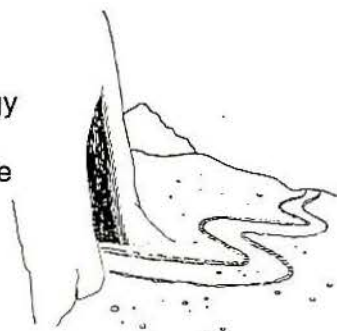


In Buildings

Patented Kaval Tapped "Point Source" antennas and Low cost CATV cable 75 or 50 Ω

In Tunnels

Low cost Trilogy 75 or 50 Ω Radiating Cable



COMBINE FOR BEST FLEXIBILITY

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COMPLETE LINE OF IN BUILDING AND TUNNEL RF EXTENSION PRODUCTS

Circle (42) on Fast Fact Card

Are We Confident Enough In EDACS To Send You To The Competition?



Say When.

If you're actively looking for a trunked radio communications system, we'll send you to see an EDACS installation, and then to a competitor's site. See both systems in action, talk to actual users about how their systems make them more efficient.

There's no question that once you've seen the best that both have to offer, you'll choose EDACS.

Public safety officers depend on EDACS to keep critical communications open in spite of explosions, fires, lightning strikes, and tropical storms. They count on EDACS because its fail soft, fault-tolerant trunking won't revert to

conventional mode in the event of site controller failure. In an emergency, you can't wait for an open channel. EDACS nonstop trunking means no waiting. And that means a fast response time.

What's more, EDACS' modular building block design is easily expanded. So your system can be modified as your needs change. That safeguards your communications investment.

EDACS. See it, and you'll believe it. To arrange your on-site visits, or for a free guide to EDACS, call Ericsson GE at 1-800-43-12345.* (In Canada, call 1-804-528-7643.)

Technology That Exceeds The Standard



*Participants in above offer must meet general qualifications. Call for more information. Ericsson GE reserves the right to cancel or amend this program at any time.

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ERICSSON



dios, pagers, cordless telephones and cellular telephones; Telepower conditioner/analyzer; Charger plus for complete nickel-cadmium battery maintenance.

New products

JB9628 for Motorola GP300 radio; JB9808 for Motorola GP300; JBMGP5B for General Electric MPG 148, 160, 450; JBMGP5C for General Electric MPG 148, 160, 450; JB1155 for Maxon SP2550, SP2850; JB1160 for Maxon SL500V, SL500U.

Circle (334)

See ad page 31

Kaval Electronics

Existing products

On-frequency-radio (OFR); repeater; booster amplifiers; line amplifiers; in-building RF distribution devices.

New products

KLA-V, KLA-U, KLA-83 line-powered cable amplifiers—VHF, UHF, 800MHz.

Circle (335)

See ad page 48

Kenwood Communications

Existing products

Booth 326

Conventional portables, mobiles, base stations, repeaters; trunked portables, mobiles and repeaters; options and accessories.

New products

TKR-9301S 900MHz trunked repeater systems—150W trunked systems from 1 to 20 channels (dispatch only or with interconnect); PLL-synthesized repeater unit with "dial-in" FCC channel frequency feature for fast set up. Advanced logic controllers provide validation, air-time accumulation, subscriber information, built-in alarm/notification features; completely integrated systems; site management hardware; duplexers; combiners; 800MHz trunked repeater systems.

Circle (336)

Kyodo West

Booths 1341, 1343

Existing products

VHF and UHF radio communications equipment ranging from mobiles and hand-helds to complete integrated systems.

New products

KG 209 fully software-driven compact hand-held transceiver.

Circle (337)

Larsen Electronics

Booth 448

Existing products

Full line of cellular antennas: mobile, permanent mount, on-glass, portable, base station, cordless repeater antennas.

Circle (338)

See ad page 43

Lease Acceptance

Booth 813

Existing products

End-user commercial leasing.

Circle (339)

Leavitt Communications

Booths 442, 444

Existing products

Motorola Radius radios and accessories.

Circle (340)

Lyncolex XIT Grounding

Booth 979

Existing products

Electrolytic grounding system for protection of telecommunications equipment and personnel; AEMC meters for ground resistance and soil resistance testing necessary for site evaluation prior to design of effective grounding systems for telecommunications sites.

New products

AEMC models 3710 and 3730 clamp-on ground resistance testers.

Circle (341)

M/A-COM

Booth 573

Existing products

RF and microwave (100MHz - 100GHz) wireless subsystems and components—base station transmitters, GaAs MMIC transmit/receive, mixers, LNAs, switches, chip sets, power amplifiers using HMCs and GMICs technologies; wireless antennas; RF connectors; fiber-optic connectors and cable assemblies; discrete semiconductors.

New products

MMIC transmit and receive; mixers; LNAs; switches; chip sets and power amplifiers using HMCs and GMICs technologies.

Circle (342)

Marketronics

Booth 1142

Existing products

Midland 1336T mobile, 70-166 portable;



Receive only

	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 58.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95

Inline (rf switched)

	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$139.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. System S/N improvement 6-14 dB typical. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR RX only or inline preamplifier today and start hearing like never before!

**Advanced
Receiver
Research**

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Circle (44) on Fast Fact Card

Catch the winning spirit.

From the forge of world-wide competition comes the new Hustler *Spirit* series of vertical antennas.

Designed to win the race to provide the highest performance and durability possible, at a price that leaves others in the dust.

If you are driven to achieve a superior signal; if you need an antenna which is virtually impervious to wind and weather; if you want the best the world has to offer, catch our new *Spirit*-and win today.

Model Shown: HS9-45070

Also Available: Models from 136 MHz. to 2 GHz, including Land Mobile, Cellular, Trunking, SMR, Paging and PCN. All models available in a variety of gain configurations.

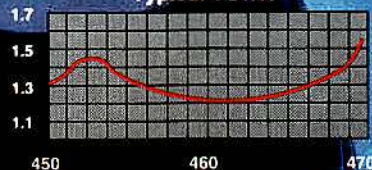
Radiation Pattern
(Relative Field)



Vertical
(0.5 Below Horizontal)

VSWR

Typical VSWR



Gain (Relative to 1/2 Dipole)



Beyond your Expectations

One Newtronics Place
Mineral Wells, Texas 76067
1-800-949-9490 • (817) 325-1386

YES, I'm interested in the new *Spirit*.
Please send me your latest Professional
Products catalog.

Name

Company

Address

City State Zip

Circle (45) on Fast Fact Card

Motorola GR300 repeater, Keynote and Advisor pagers; CES repeater maker; Newmar E.R.C. 12-15, Power-Pac UPS; Andrew Helix cable and connectors.

New products

Japan Radio SUD 404 single-channel radiotelephone; Motorola Visar portable radio, M120 mobile; Megapage MP1000 fully automatic paging scheduler, load management, LED signs; Marketronics RT-4 and RT-8 rural telephone systems.

Circle (343)

Maxon America Booth 102

Existing products

SP-2000 VHF and UHF synthesized hand-held; SM-4000 VHF and UHF synthesized mobile; TP-4800 800MHz trunking portable radio; CP-0500 VHF and UHF crystal hand-held; SP-5050 HD lowband hand portable; SND numeric pager—VHF, UHF, 900MHz POCSAG.

Circle (344)

Maxrad Booths 456, 458, 460, 462

Existing products

Land mobile, base station and cellular antennas and related accessories.

Circle (345)

Meridian Communications Booth 153

Existing products

38 antenna sites.

New products

Banning Peak.

Circle (346)

See ad page 37, classifieds

Merry Electronics Booth 679

Existing products

General microphones; marine mics; hands-free mics; handset and bracket; noise-cancelling mics; base station mics; DTMF mics; microphone accessories; power mics; speaker mics; microphone tester; dynamic mylar speaker; dynamic elements for microphones; microphone cartridge and transducer.

New products

microphones—models DMC501; DMC502; DMC503; DMC579; DMC586; DMC589; DMC590; DMC595; DMC596; DMC593

Circle (347)

Micropath/Rocky Mountain Communications Booth 775

Existing products

Microwave engineering programs; Micropath 2000 multi-TX predicted area coverage software; VHF and UHF link analysis program.

New products

Micropath 2000 Visual Predicted Area Coverage program (VPAC).

Circle (348)

Midian Electronics Booths 101, 103, 105

Existing products

Universal encoder/decoder boards; boxes; mics; scramblers; station identifiers; ANIs; radiotelephone trunking products; paging; CAD systems; tone/digital squelch products.

New products

Midian RC-10, RD-10, RD-1 remote control systems; UED-1M, RT-8M MAXTVS scramblers for the Maxon SP2000/SL70 specific products.

Circle (349)

See ad page 32F

Midland Land Mobile Radio Booth 318

Existing products

Syn-Tech XTR mobile radios and desktop stations; Syn-Tech II mobile radios; Syn-Tech XTR portables; 70-0000 series portables; Base-Tech base station series; PLL Express series mobiles.

New products

70-9090A trunking repeaters; 70-9020 trunking mobiles; 70-942 trunking controllers; 70-2470 modem/XTR mobiles and desktops.

Circle (350)

Mobile Mark Booths 366, 368

Existing products

On-window antennas in both 3dB and 5dB gain; Clip-on antennas for portable applications available with traditional cable connections, new coupler connections and a cordless version; RM series antennas for commercial land mobile applications; fixed-station and cell site antennas cover cellular and PCS frequencies.

New products

Mini-Mark glass-mount antenna for cellular applications—3½ inches tall with 3dB gain; Maxi-Mark glass-mount antenna with a 5dB gain enclosed coil whip; unity gain RF series antenna features a flexible whip that withstands car washes and low-clearance areas; RM series offers both 3dB and 5dB gain whips.

Circle (351)

See ad page 74

Mobile Radio Technology Booths 373, 375

Existing products

Written to keep industry professionals up to date on the latest in equipment, technology, techniques, business developments, legal and regulatory matters, **MRT** is recognized as the leading source of technology-oriented industry guidance. Visit our booth to pick up a copy and sign up for your free magazine subscription.

Circle (352)

Monark International Booths 1345, 1347

Existing products

Cp-ter synthesized portable radios; Cp-ter QTX synthesized radiotelephones; HD series heavy-duty diecast portables; Kryp-ter speech encryption speaker/microphones.

New products

Signet series 2000 radiotelephones (portable).

Circle (353)

See ad page 28

Motorola Booths 534, 540, 543, 545 Land Mobile Product Sector

Existing products

Formatted portable radios: HT-1000, MT-2000, MTX-8000 and MTX-9000; Radius radios: GP-300, P-100, SP-10 portables; GM-300, M-10 and M-120 mobiles.

New Products

Visar portable small, high-powered FM two-way radio.

Circle (354)

See classified ads

Motorola Booths 534, 540, 543, 545 Test Equipment Products

Existing products

R-2600C/CBS cellular base site testing system; R-2600C communications system analyzer; R-2550 communications system analyzer.

Circle (355)

See ad page 17

Multiplier Industries Booth 266

Existing products

Portable land mobile radio batteries and accesso-

ries; portable cellular telephone batteries and accessories.

New products

Batteries and accessories for GP300, HT1000 and MT2000; intrinsically safe batteries for Saber HT600 and GT300.

Circle (356)

MX-COM Booth 466

Existing products

Cypher-MX VSB modules for two-way radio high-security analog scrambling; PVT Squelch two-way radio privacy adapters; CADi computer-aided dispatch modules for PC-based dispatching.

New products

MXP1183GP PVT Squelch privacy adapter for the Radius GP300 and P110 provides affordable voice privacy.

Circle (357)

See ad page 7

Natcom Booth 1357

Existing products

Repair service and refurbished pager sales.

Circle (358)

See ad page 64, 79

Newmar Booth 1652

Existing products

PHd 25 3-step adjustable "smart" fully automatic battery charger; dc-to-dc converters; rack-mount power rack system.

New products

Model 115-48-30RM power rack system with battery eliminator and charger; model 48-24-15RM dc-to-dc converter; model DST breaker distribution panel, mounted on communication relay rack.

Circle (359)

See classified ads

Norcomm Booths 1642, 1644

Existing products

Data signaling encoders and decoders: DTMF, CTCSS, digital coded squelch, notch and bandpass filters, single and two-tone decode and encode, 1,500MHz and 2,805MHz decode, as well as custom-designed encoders and decoders.

New products

NC4000 multi-function DTMF decoder; NC421 DTMF decoder in enclosure for vehicles; NC401 DTMF decoder with enhanced features.

Circle (360)

Nutel Electronics Booth 125

Existing products

8000 series point-to-point 790MHz-2,500MHz radios; 9000 series wideband 1.5GHz/2GHz radios; 9500 series direct-to-line frequency division multiplexers.

New products

Model 1000 series low-cost, microprocessor-controlled radios.

Circle (361)

Optaphone Systems, Booths 166, 168 a division of Carlson Communications

Existing products

Optaphone Plus point-to-point telephone system; Optaphone STAR multi-point telephone system.

Circle (362)

Orbacom Systems Booths 805, 807, 809, 811

Existing products

TDM-150 distributed microprocessor console

The New Standard in Radio Communications Test Equipment

**The FM/AM-1600S
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control to provide
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performance and
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The color CRT displays all information necessary to test an RF transmitter or receiver. Keystrokes are kept to a minimum by the extensive use of "soft keys". The user can even select the colors to be displayed from a 16 color palette. The result is a level of operator convenience never before encountered in a service monitor.

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The digitized Spectrum Analyzer provides scan widths from 1 kHz/div to full scan, plus store, recall, compare and peak hold trace modes. Log scales of 10 or 2 dB/div and amplitude units scaled in dBm, dB μ V, dBmV, dBV or dB μ W.

Additional unique features include Tracking Generator; digitized 1 MHz Oscilloscope; 2 AF Function Generators; Bit Error Rate (BER) Meter and multiprotocol Data Communications Generator; Power Meter with extended dynamic range of 0.2 mW to 200W; "store" and "recall" of front panel setups; RS-232C, IEEE 488.2-1987, SCSI (ANSI X3.131-1986) and EGA interfaces.

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Circle (46) on Fast Fact Card
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systems—modular, CRT, desktop; Calida + self-contained, fully user-programmable stand-alone desktop unit.
Circle (363)

See ad page 23

Pace **Booth 174**

Existing products _____
 PRC 2000 advanced SMT/Thru-hole assembly and repair workstation; process monitor for soldering/desoldering systems; Pik & Paste self-contained liquid dispensing and component handling system; MicroChine variable speed

miniature machining system.

New products _____
 Sensatemp soldering stations with new Sodr-Pen; fume extraction systems.
Circle (364)

Packetcluster Systems **Booth 162**

Existing products _____
 Mobile data communications systems for public safety; GPS-based automatic vehicle location systems.
New products _____

PacketTrack automatic vehicle location system.
Circle (365)

PageTek **Booth 1648**

Existing products _____
 ProTek-24 remote monitor, alert and control system; ProTek Jr. remote monitor, alert and control system.
New products _____
 ProTekTor remote tower light monitor.
Circle (366)

PanaVise Products **Booths 1350, 1352**

Existing products _____
 Cellular phone mounts; mobile data terminal mounts; electronic servicing tools.
New products _____
 PanaVise "Uni-Flex" 796 & 797 available in 10", 12", 14".
Circle (367)

Pathcom **Booths 467, 469**

Existing products _____
 Guyed towers; self-supporting towers; monopoles.
Circle (368)

Pipo Communications **Booths 109, 111**

Existing products _____
 DTMF encoder; DTMF ANI ENI.
Circle (369)

PolyPhaser **Booth 1066**

Existing products _____
 Coaxial lightning/EMP protectors (dc-6GHz); telephone/T1 twisted pair; battery/power line; tower strobe; custom-engineered protection solutions.
Circle (370) See ad page 14

Quantum Resources **Booth 1173**

Existing products _____
 Total site development services, including everything from land acquisition to complete data referencing.
Circle (371)

Racom Products **Booth 1680**

Existing products _____
 700 PC-programmable automatic Morse Code station identifiers; 1402 switch/PC-programmable automatic Morse Code station ID; 1601 automatic voice station ID unit; Life-Tel C.T.S.—Biomedical Cellular Telemetry System.
New products _____
 1601TM tower light monitoring system.
Circle (372)

RadioMate **Booths 882, 884**

Existing products _____
 Headsets for portables, mobiles and base stations; Switchmate for use with telephone and two-way radio.
Circle (373) See ad page 74

Radio Systems **Booth 803**

Existing products _____
 Submersible hand-held portable radios from 30MHz to 512MHz; transportable weatherproof repeater systems and vox systems.
New products _____
 Model PR8077 frequency hopping 100-channel tactical submersible hand-held radio with built-



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Circle (47) on Fast Fact Card

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- DIGITAL AND ANALOG MODULATION AMPLITUDES AND DELAYS REMOTELY ADJUSTABLE
- MICROPROCESSOR CONTROLLED THROUGHOUT, ALLOWING: REMOTE MONITORING (INCLUDING SETABLE ALARM LEVELS) OF 15 FUNCTIONS THROUGHOUT THE SYSTEM
- MOST COMPACT HIGH POWER PAGER IN THE INDUSTRY
- POWER OUTPUTS FROM 10W TO 500W AVAILABLE
- AUXILIARY COMPUTER PORT ALLOWS FOR COMMUNICATION WITH OTHER TRANSMITTERS, INCLUDING HOT STANDBY SYSTEMS
- HIGH STABILITY REFERENCE OSCILLATOR: .02 PPM STANDARD .002 PPM AVAILABLE
- ALL MODES OF DIGITAL AND ANALOG PAGING ARE SUPPORTED, UPGRADABLE TO FOUR LEVEL DIGITAL WHEN STANDARDS ARRIVE
- COMPATIBLE WITH VIRTUALLY ALL SIMULCAST SYSTEM CONTROLLERS

in automatic antenna tuner—features three modes: hopping, clear and encrypted.
Circle (374)

Ranger Communications Booth 974

Existing products
UHF and VHF portable radios; mobile radios; base station/repeaters; digital paging transmitters; mobile repeaters; rural telephone systems.

New products
Ranger RCI-7100 16-channel synthesized portable hand-held radio.
Circle (375)

Relm Communications Booth 202

Existing products
RSP series portable radios; Mini-com PT series portable radios; WHS series portable radios; Utili-com UC2200 portable radios; RM series mobile radios; Mini-com SL series mobile radios; Mini-com SM series mobile radios; RH, RFH series mobile radios; Mini-Com ET series trunking mobile radios; Relm series repeaters and base stations.

New products
Utili-com UC4200; Mini-com PTU 46B; WHS450.
Circle (376)

RF Industries Booth 464

Existing products
RFA-4024 Unadapt kit; RFA-4005 crimping tool and die kits; RFU-603-2 shortened mini UHF plugs and sockets; RFU-630 and RFU-631 mini UHF R/A adapters male-to-female.

New products
RFB-1130-3 50Ω and RFB 1730-3 75Ω three-port adapters; RFU-642 mini-UHF cellular adapter; RSA-2330, RSA-2385, RSA-2387 SMA connectors; RFA-4030 universal flush-mount wall plate system; RFA 4080 stainless-steel cutters and pliers.
Circle (377)

Ritron Booth 120

Existing products
Patriot two-way radios; Jobcom two-way radios; Ritron telemetry and leased line bypass.

New products
RTX-050 Patriot lowband synthesized portable.
Circle (378) See ad page 47

Rohn Booth 762

Existing products
Guyed and self-supporting towers; steel or concrete poles; fiberglass or concrete equipment shelters.

Circle (379)

Sabre Communications Booth 973

Existing products
Guyed and self-supporting towers; HF antenna systems; pre-built equipment shelters.
Circle (380)

Sage Data Systems Booth 240

Existing products
CSERVICE service management system for invoicing, work tickets, inventory, service history, maintenance contract profitability, technician productivity, air-time billing, recurring billing.
Circle (381)

Samlex America Booths 483, 485

Existing products
Regulated dc power supply; dc-ac inverters; switch mode power supply; linear power supply; dc-dc converters.

New products
SPS-1204, 1206, 1208 switch mode power supplies; SPS-1203 switch mode power supply; SCP-160 dc-dc converter; CSA UL-listed linear power supply.
Circle (382)

Scala Electronic Booths 1067, 1069, 1071

Existing products
Fixed-station antennas for two-way, trunking, paging, cellular, PCS and point-to-point communications.

New products
65° Americell panel antennas; PCS panel antennas; autotune combiner for the 806MHz-894MHz band.
Circle (383) See ad page 78

Schlumberger Technologies Booths 785, 787

Existing products
4015-Stabilock radio test set; 4031D-Stabilock digital cellular radio tester (base stations and mobiles).

New products
7676-Flash mini OTDR; 4032 and 4032D-Stabilock radio test set.
Circle (384) See ad page 21

SEA Booth 144

Existing products
220MHz narrowband radio systems—trunked and conventional; ESP1000 220MHz narrowband repeaters; ESP504 220MHz narrowband mobile radios; ESP520 220MHz narrowband mobile radios.

Circle (385)

Selectone Booth 666

Existing products
Various tone signaling encoders and decoders; ST-20, ST-25A and ST-25AGP voice encryption modules; Data Messenger mobile data system; Smarttrunk II radiotelephone trunking system; ANI system.

New products
Smarttrunk II digital radiotelephone trunking system.
Circle (386) See ad page 3

Setcom Booth 1158

Existing products
Headsets; motorcycle helmet comkits and face mask (self-contained breathing apparatus) comkits for use with both portable and mobile radios; vehicular intercom/radio mixer systems.
Circle (387) See ad page 73

Sharp Communications Booths 1476, 1478

Existing products
GE Mobile Communications mobile and portable conventional and trunked radios; Telewave site management equipment and wattmeters; Whelen safety and warning signals; RFI connectors, cables and kits.

New products
Midland Land Mobile Radio portables and mobiles; Autoloader 500N digital on-hold messaging system with night-answer capabilities.
Circle (388) See classified ads

Shinwa Communications Booth 1444

Existing products
Checkmate III; Pen pager; Moe pager; GII series portable SR001 all-band receiver.

New products
Checkmate IV; STAT series portable radio and mobile.
Circle (389) See ad page 38

Sigstone Booths 1076, 1078

Existing products
Mobi-STAT computer-aided dispatch and tracking system; P1356 status reporting and vehicle tracking terminal unit; M2400 range of signaling microphones; S1530 non-predictive, sequential signaling, mobile or portable encoder and decoder; A1200 range of ANI encoders; T2100 series of alarm monitoring and remote control units.

New products
D8100 mobile data and status reporting terminal; D8902/01 bar code reader for mobile data systems; D8904/01 GPS receiver for mobile data systems; Mobi-Script computer-aided dispatch mobile data system; VCS2100 series of simplex, full or half-duplex telephone interconnect products; TTM9000 range of DTMF microphones; SR-7110 simplex repeater with CTCSS and 45-second storage, optional 60, 75 or 90 seconds storage.
Circle (390)

Sinclair Radio Laboratories Booth 634

Existing products
Network site equipment; antennas; duplexers; receiver multicouplers; combiners; cavity filters; mobile duplexers; coaxial cables; connectors; accessories; clamps; mounting hardware.

New products
SRL-411 low I.M. cellular antenna; SLR-490 broadband cellular/trunking antenna; SRL-470, 475 cellular panel antennas; AMV-6A power/VSWR monitor; TC-4222HPBP high-power two-channel paging combiner.
Circle (391) See ad page 57

Slattery Software Booth 1074

Existing products
Quickform software for FCC licensing; Minute Quotes software for proposals.
Circle (392)

SMC Electro-Mount Booths 1262, 1264

Existing products
Installation hardware for mobile communication equipment; pedestal mounts; slim mounts; uni-lok mounts; flex mounts; heavy-duty mounts; installation hardware and accessories.

New products
Vinyl-clad flex mount.
Circle (393)

SoftWright Booth 484

Existing products
TAP terrain analysis package—PC-based software to perform evaluation of existing or proposed transmitter sites; radio coverage predictions; microwave; cellular; paging; broadcasting; and two-way radio system design.

New products
Terrain analysis package—Version 2.4 RF design software.
Circle (394) See classified ads

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The SRL-490 expands the wireless network

This highly versatile and durable antenna provides heavy null fill for systems where excellent close-in coverage is required.

- 150 MHz bandwidth, 806-956 MHz
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Solar Electric Specialties Booth 1462

Existing products Photovoltaic modules; batteries; enclosures; charge regulators.

New products Mapps, BetrSolar, SunTalker packaged solar electric power systems.

Circle (395) See ad page 82

Sonic Communications Booth not assigned

Existing products HL, HM, HH series headsets, both PTT and Vox; ERS-601 series ear microphones; TM-201 series throat microphones; CA series covert surveillance accessories; MSK series motorcycle, auto racing accessories.

New products Sonic covert video equipment.

Circle (396) See ad page 54

Spectrum Communications Booths 372, 374

Existing products SCT1500 paging transmitter; ST250A paging transmitter; SCT500 link transmitter; SCR500 link receivers; SCA100 high-power amps; SCP30 heavy-duty power supply; SCR1400 repeater; S-7R repeater.

New products Simulcast-capable, ultra-high stability frequency generator.

Circle (397)

Standard Communications Booth 652

Existing products HX581 dual protocol trunking hand-held;

HX240 conventional VHF/UHF hand-held; HX241 conventional VHF/UHF hand-held; LMR5/6 100W, synthesized UHF repeater and 160W VHF, synthesized repeater.

New products HX580T+ dual protocol trunking hand-held c/w

DTMF and alpha display; HX582T dual protocol trunking hand-held c/w scan and alpha display; LMR8 80W continuous, synthesized 800MHz repeater; GX5810 dual protocol trunking mobile, 15W, 10/1 scan data ready.

Circle (398)

Steelgard Booth 1563

Existing products Communications equipment shelters and overseas communications equipment shelters.

Circle (399)

Sti-Co Industries Booths 1062, 1064

Existing products Disguised mobile two-way antennas, including custom fender-mount lowband, highband, UHF and broadband models; cellular look-alike VHF and UHF antennas; cellular look-alike dualband antennas; low profile transit antennas in highband, UHF, 800MHz and 900MHz frequencies; special-use antennas; couplers; tuners; dual-matched systems.

New products New Euro-Asian models: custom fender-mount disguised two-way antennas for 1994 imported cars, including model MPV for Mazda MPV; NAS for Nissan Altima and Stanza; NPF for

Nissan Pathfinder; NSE for Nissan Sentra; FMV for Nissan Quest; TPR for Toyota Previa; TQV for Toyota T-100; VGO for Volkswagen Golf and Jetta; IRO for Isuzu Rodeo.

Circle (400) See ad page 40

Tait Electronics Booth 566

Existing products T800 base station radios; T2000 mobile radios.

New products T805 automated simulcast.

Circle (401) See ad pages 42, 59

Talley Electronics Booths 155, 157, 159, 161

Existing products Radio communications equipment and accessories.

Circle (402)

TEAC America Booth 141

Existing products CR series VHS analog communications recorders; IR-100 digital instant communication recorders; DCR series digital multi-format communications recorders.

New products DCR series multi-format, networking digital communication recorders; IR-100 Mk. 30-minute self-contained digital instant communication recorder.

Circle (403)

Tekk Booth not assigned

Existing products PCI-150A one-channel, 1W and 2W VHF hand-

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Circle (51) on Fast Fact Card



Simply Simulcast: The TAIT quasi-sync system

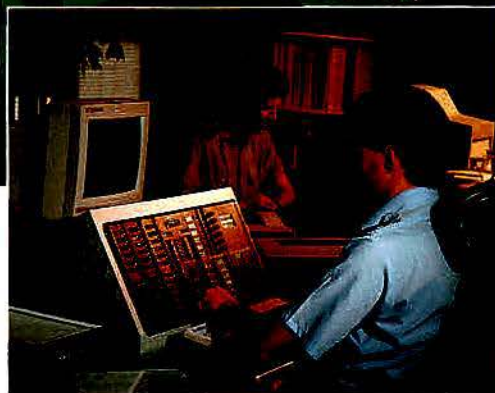
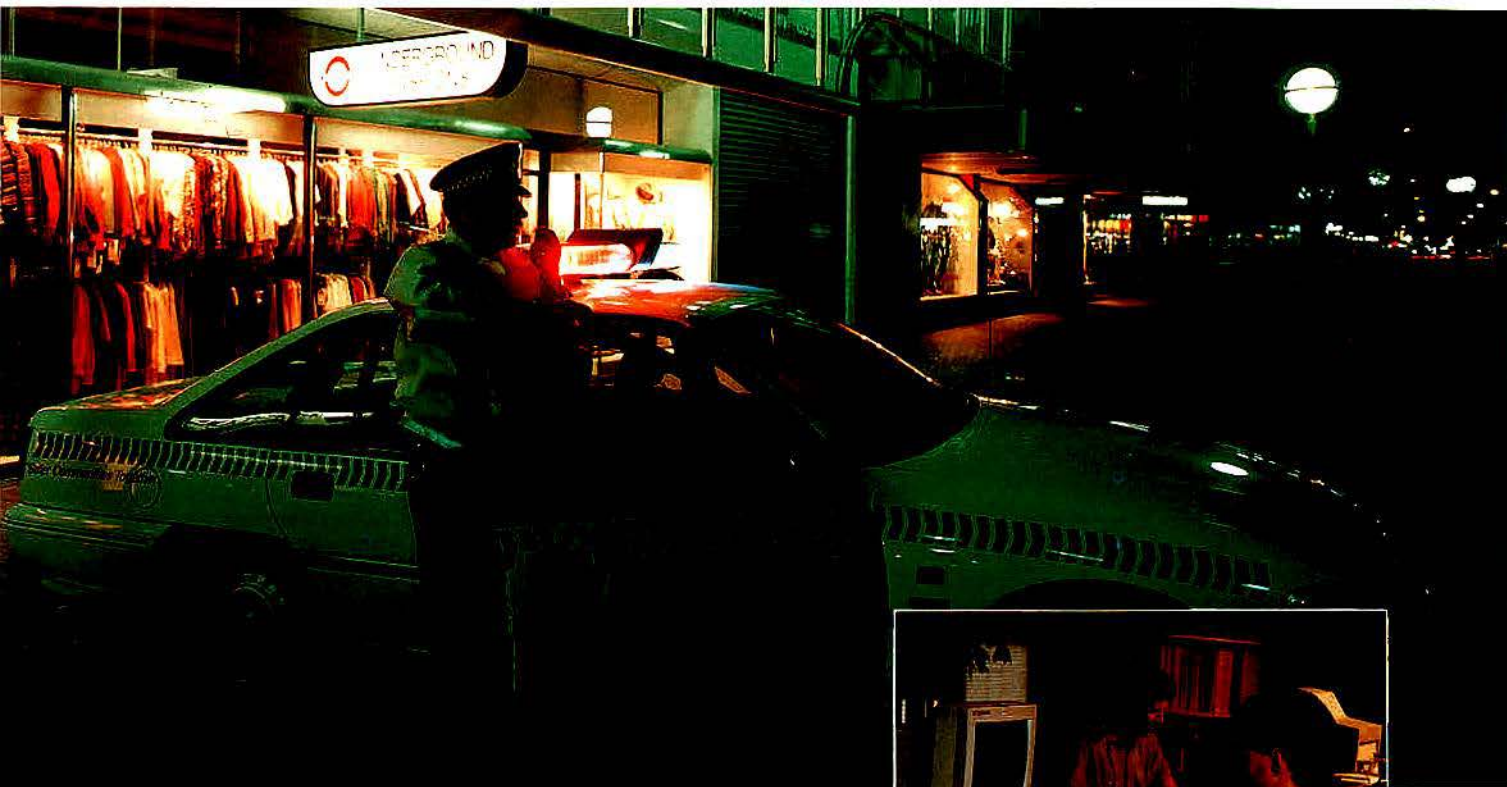
Communication is crucial to the co-ordination of resources whether it be saving lives or property or directing the fleet.

Of strategic importance in the event of emergency, is the reliability of the communication system and a facility providing everyone on the network with the ability to hear.

The quasi-sync system – unique to Tait – provides it all.

The technology provides wide area coverage on a single channel, and what's more, time spent on routine maintenance is merely minutes.

To learn more about the quasi-sync system just contact a Tait system representative by calling any of the numbers below.



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Fax: (64) (3) 358-3636

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Tait Mobile Radio Ltd.
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Fax: (44) (480) 411996

USA
Tait Electronics (USA) Inc.
Phone: (1) (713) 984-8684
Fax: (1) (713) 468-6944
Toll Free :1-800-222-1255

helds; TS-200 two-channel, 2W and 5W VHF hand-helds; T-20 one-channel, 2W VHF hand-held; T-50 four-channel, 5W VHF hand-held; T-60 two-channel, 4W UHF hand-held.

New products

T-80 10-channel 5W/1W VHF hand-held, synthesized; NP-150 numeric display pager, VHF, POCSAG.

Circle (404)

Telemobile

Booth 362

Existing products

Phonelink wireless phone extension system

(point-to-point, point-to-mobile and point-to-hand-held); System 35 multi-user rural telephone system; MRRT multi-access rural radiotelephone; two-way radios and accessories; Skytrunk satellite equipment; Landtrunk digital switch equipment.

New products

Phonelink PTEL series for wireless fax requirements plus phone company option (polarity reversal, payphone metering, scrambler and DTMF regeneration).

Circle (405)

Telephonics

Booths 147, 149

Existing products

Sure-Comm wireless intercommunication system.

Circle (406)

Telewave

Booth 772

Existing products

MI01 series combiners; TWR series Rx distribution panels; ANT series antennas; 44A series wattmeters; TWPC series cavities; TPRD series duplexers; TPCP series preselectors; T series isolators.

Circle (407)

See ad page 88

Telex

Booths 579, 581

Existing products

EM-200 Ear-Mike; EM-300 Ear-Mike; Magnacom and MagnaRope intercom systems; portable radio headsets.

New products

E-Comm EC-100 Ear-Mike; Directly interfaceable portable radio headsets; HS-650I dual-sided and HS-651I single-sided lightweights; HS-750I dual-sided and HS-751I single-sided medium weights; HS-925I noise attenuating overhead; HS-850I noise attenuating under helmet; HS-975I medium weight noise-reduction headset.

Circle (408)

See ad page 71

Tessco

Booth 866

Existing products

Site management products; cellular and two-way radio accessories; mobile and portable antennas; bench and test equipment.

Circle (409)

See ad page 70

Time Microwave Systems

Booth 585

Existing products

LMR-400, LMR-600 series flexible, low-loss communications cables; nu-TRAC triaxial antenna cables; Alumifoam smooth wall aluminum cables.

New products

7/8" LMR-1200 and 1/4" LMR-1700 flexible communications cables; connector weatherproofing kit; low-loss jumper cables.

Circle (410)

See ad page 81

TowerWatch

Booth 1247

Existing products

Smart light sensor and tower monitoring service.

Circle (411)

See classified ads

TPL Communications

Booths 831, 833

Existing products

RF power amplifier; mobile converter chargers; base station/repeater amplifiers.

Circle (412)

See ad page 76

Transcrypt International

Booth 756

Existing products

CVP (Crypto-Voice-Plus) series scramblers; continuous synchronization system scramblers; international scramblers.

New products

Transpulse ADAPT (Applications Development and Programming Toolkit); MicroTAC cellular scrambler; landline telephone scrambler.

Circle (413)

See ad page 5

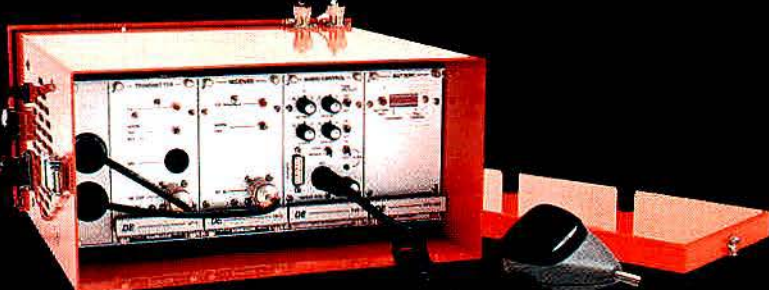
Trident Micro Systems

Booth 226

Existing products

TNT-100 series logic and interconnect control-

THE PEAK PERFORMER



PORTABLE RADIO REPEATER

**THE ULTIMATE IN RUGGED AND DEPENDABLE
PORTABLE RADIO COMMUNICATIONS**

Easily identified by its emergency colour, the portable radio repeater base station is designed to mate directly with Daniels' Standard RF modules (FCC/DOC Approved)

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Circle (53) on Fast Fact Card

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✓ Patented wide dynamic range amplifier

✓ 800/900 MHz

✓ 6 to 48 output ports

✓ For cellular, SMR and data transmission applications

Trontech receiver multicouplers are versatile customer configurable units with exceptional performance. By combining ultra low loss filters and Trontech's patented wide dynamic amplifier technology we are able to achieve very high third order intercept points and still maintain extremely low noise figures, even with low overall gains.

Wireline, non wireline, trunking and other service frequency bands are available. Trontech can custom configure the optimum combination of filtering and dynamic range to address your unique applications. For more information, contact us at TRONTECH.

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FREQUENCY (MHZ)	OUTPUT PORTS	NOISE FIGURE SYSTEM (dB)	GAIN SYSTEM (dB)	IP3 SYSTEM (dBm)
806-824	6	3	26	43
806-824	12	3	23	40
824-849	6	3	26	43
824-849	18	3	12	34
896-902	24	2	30	38
896-902	48	2	22	32

Other gain and power configurations also available



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Expo

lers; CR-355 interconnect call router; VM-400 voice mail; remote power monitor; RVL remote validator loggers; system analyzer; M-500 Motorola airline logger; MAC-10 mobile audio compandor.

New products

DL-40 mobile data terminal; DM-30 dispatch monitor; RP-20 remote programmer; GPS software; MP-7 mobile programmable module.

Circle (414)

See ad page 46

Triplett

Booth 1361

Existing products

Triplett 5000E portable cellular test set.

Circle (415)

TWR Lighting

Booth 1170

Existing products

FAA-approved aviation obstruction lighting, including incandescent and medium-intensity strobes; junction boxes; and alarmed and unalarmed controllers.

Circle (416)

Tx Rx Systems

Booth 856

Existing products

Duplexers; filters; multicouplers; signal boosters; RF system products and associated hardware.

Circle (417)

Uniden America

Booth 602, 612

Existing products

MRS3105 Esas switch; SMU4525, IMU 3100

UHF mobiles; SPU416, SPU 480 UHF portables; SMH1525, IMH4100 VHF mobiles; SPH516, SPH580 VHF portables; SMS303T, SMS316, SMS825, SMS835 SMS 8035 800MHz mobiles; SPS310, SPS320, SPS330 800MHz portables; IMH200, MRS204 220MHz mobiles; SPS920 900MHz portables; SMS925, SMS935 900MHz mobiles.

New products

MRS3105 Esas switch—digital matrix switch (220MHz, 800MHz, 900MHz); MRS204 Uniden 220MHz repeater system; IMH200 Uniden 220MHz mobile; SMU 4525 UHF mobile; SMH1525 VHF mobile; SMS8035 800MHz mobile.

Circle (418)

Valmont Industries

Booths 267, 269

Existing products

Guyed lattice towers to 800'; free-standing lattice towers to 400'; tapered tubular steel monopoles to 250'.

New products

24" face pre-welded tubular guyed tower; various antenna mounts; platforms; T-arms; curved arms; embedded steel monopoles; "Tree Pole" monopole that looks like a pine tree.

Circle (419)

VCP Communications

Booth 1450

Existing products

Motorola Keynote; Uniden numeric and alpha-

numeric pagers; Panasonic numeric pagers; Antenna Company antennas.

New products

Motorola SiteMate in-house paging system.

Circle (420)

Vega

Booth 800

Existing products

C-5200 10-line, four-frequency console that mounts in console furniture; C-1614 six-line, four-frequency tone-remote console; C-535 three-line de-remote console in desk-mic and wall-mount versions; 1223C tone-remote adapter and 1224, four-frequency module on the Telco type 10/400-type cards.

New products

CP-1 crosspatch for C-5112 console; CP-12R crosspatch for C-5200 console; rack-mounting versions of "dispatcher" consoles such as C-1614.

Circle (421)

See ad page 1

Vetex/Yaesu

Booth 344

Existing products

Portables, mobiles; accessories for business, industry and public safety.

Circle (422)

See ad IBC

Visiplex Communications

Booth 1277

Existing products

VS5100 multi-user radio paging system; VS6100 multi-user radio paging system.

New products

VS2100 desktop radio paging system; TM200

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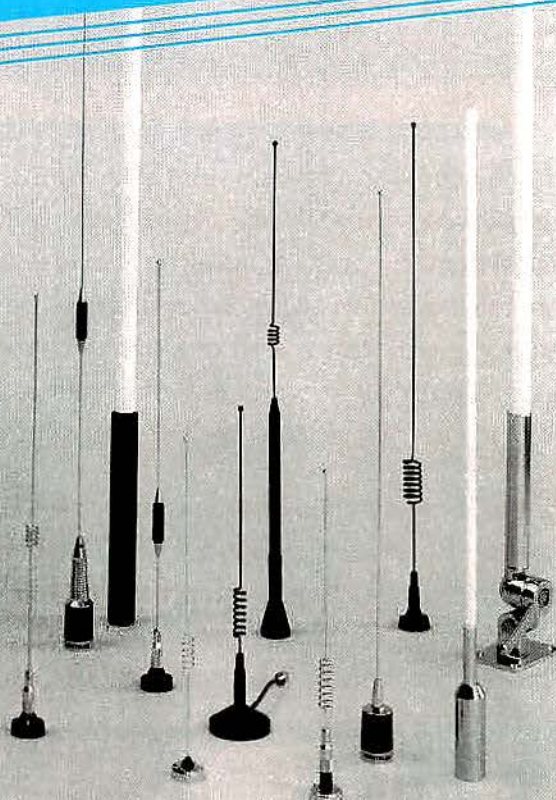
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telemanager multi-user messaging system.
Circle (423)

W&W Associates

Booths 250, 252

Existing products _____
 Replacement batteries for two-way radios, cellular and cordless telephones, pocket pagers; laptop batteries and chargers for two-way radios.

New products _____
 Replacement batteries for Vertex/Yaesu VX500, FT-11R/41R; Motorola Radius GP300; Kenwood TH-22AT/42AT; ICOM W21AT, IC-2GXAT, IC-U81T; Standard HX580; Maxon SP2000; GE Monogram; six-station charger for two-way batteries; additional charging cups for Mastercharger I & II series; cellular replacement batteries for Audiovox, Fujitsu, Diamondtel, Mitsubishi, Motorola, NEC, Nokia, OKI, Panasonic, Philips, Siemens, Sony, Technophone and Uniden.

Circle (424)

See ad page 32A

Wacom Products **Booths 574, 576, 578**

Existing products _____
 Coaxial cavity filters; duplexers; transmitter-combiner and receiver multicoupler systems operating in the 30MHz to 960MHz band.
Circle (425)

Wavetek **Booths 562, 564**
Communications Division

Existing products _____
 3600D digital-analog cellular test set; 600CAT

cellular activation tester; 2100/300 pager test; 400 antenna tester; 3000S service monitor.

New products _____
 3600D digital-analog cellular test set.
Circle (426)

Western Towers **Booth 765**

Existing products _____
 Antenna support structures; self-supporting towers; guyed towers; monopoles; log periodic, off-air reception antennas.

New products _____
 Fold-over towers to 40'.
Circle (427)

Willmar Technical College **Booth not assigned**

Existing products _____
 Information will be available about the college, and a representative will be on-hand to explain Willmar Tech's mobile communications technician training program.
Circle (428)

WirelessWorld magazine **Booths 373, 375**

Existing products _____
 WirelessWorld is published by the same people who bring you *Cellular Business* and *Mobile Radio Technology*. This new quarterly is the information source that provides market updates, engineering information and the latest news for the wireless personal communications industry. It is written and edited for cellular carriers, pag-

ing carriers, common carriers, IXCs, LECs, wireless applicants and licensees, SMR providers, cable service providers, and other wireless product and service providers, as well as end-users.
Circle (429)

Zetron **Booth 628**

Existing products _____
 Microphones; paging encoders; interconnects; tone panels and repeater controllers; recall recorders; paging terminals; alarm monitor/control systems; fire station alerting system; paging system components; consoles; trunking products; rural telephony; modular dispatch/PSAP; digital hybrids; wide-area networks; billing software.

New products _____
 Model 1517 SentiDial; 7D+ dispatch control station; 4116B rack-mount dispatch console; 4117 receiver monitor panel; 104 trunked radio adapter; model 71 RemotaPhone; 47R Racs site controller; 640 DAPT-ALPHA; 4217 video console; DeadBolt lightning arrestor.

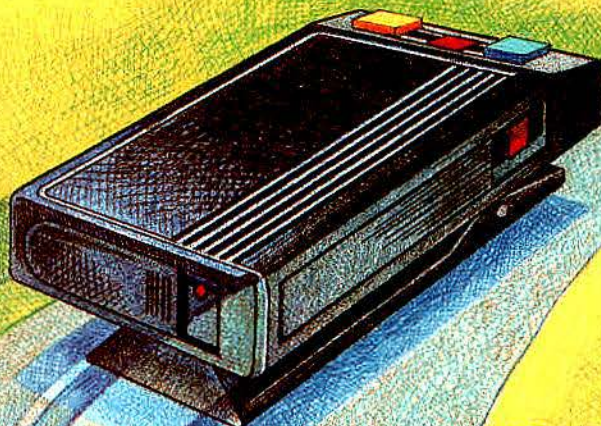
Circle (430)

See ad pages 32E, 87



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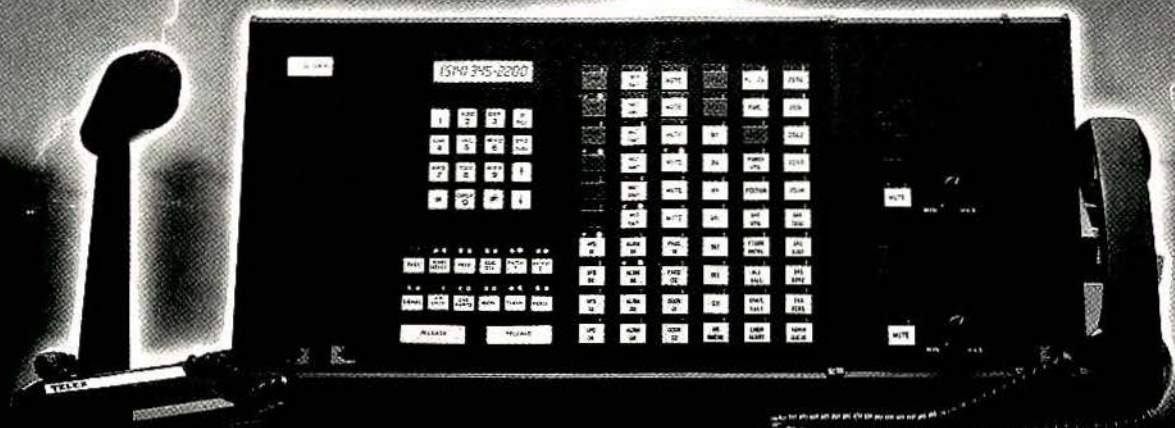
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One step forward . . .

By Robert H. Schwaninger Jr.

A common problem facing creative designers of equipment is FCC rule compliance.

For example: You come up with a device that prevents mid-air aircraft collisions, assists in routing and has applications in fleet management of ground-based vehicles — in short, a black-box system that is the greatest thing since the crystal set — but if no radio spectrum is allocated for it, your invention becomes a commercially useless, albeit interesting, idea.

At this juncture, the designer must explore his options. First, he can apply for a patent and tuck the design in a closet until usable spectrum is available. Second, he can petition the FCC for a spectrum allocation pursuant to a rulemaking — a pro-

cess that under the best of circumstances might take "only" 36 months. Third, the device can be redesigned to use a different frequency band that may or may not be appropriate to deliver the service. Finally,

petitioners, and the whole operation will be shut down.

Pioneer's preference

The FCC wrestled with this problem and adopted a "pioneer's preference" to award spectrum to system designers who devise products that use radio spectrum innovatively to deliver valuable services in the public interest. In theory, these awards appear to be a great step toward producing the desired result — giving spectrum to the innovative designer who produces a great product. However, in many pioneer's preference cases, theory and reality are not the same.

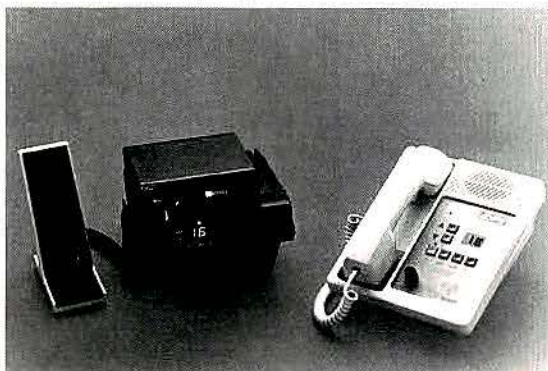
Witness the personal communications services (PCS) proceedings wherein a number of entities filed for pioneer's preferences, claiming innovative methods of delivering PCS to the public and the right to preferences in future licensing proceedings. At some point, the proceeding became increasingly acrimonious as one claimant stated that its method was more innovative than that of another would-be pioneer. The second claimant shot back that its idea was better and, besides, its opponent's "new" idea actually was developed in 1938 and was hardly new.

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC.

the device might be designed, sold and operated without authority. Eventually, of course, the FCC will be alerted by com-

*Despite the benefits
which result from its
introduction, new
technology can cause
havoc in the
marketplace.*

GET CONTROL...



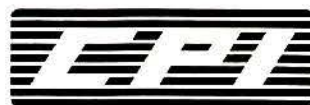
...Remote control, of upto 16 channels - Radius M200, GM300 & Maxtrac 300 series radios

The CPI model MCR210 remote and MCR series interface panel will allow you to remote control Radius or Maxtrac radios, upto sixteen channels, over any two wire voice grade circuit.

The MCR210 remote control system provides LED displays for remote channel indication, channel up and down buttons, PTT indicator, on-hook PTT capability, monitor button and indicator, intercom capability between parallel remotes and the radio, scan control button and indicator for those radios so equipped and speaker volume control.

Features

- Simple installation - No soldering, cutting or crimping.
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- Remote transmissions heard over radio speaker.
- Radio transmissions monitored on remote speaker.
- Uses any two wire voice grade circuit.



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'Innovative?'

Meanwhile, the FCC has the impossible task of deciding the meaning of the word "innovative" as it applies to something as dynamic as radio technology. By the time the FCC might decide a particular matter, technology may have progressed to the point where any innovative idea has become conventional, common knowledge.

Conversely, if the FCC were to award spectrum promptly to every new idea, it could award all of the unallocated radio spectrum in six months. If there is one thing our industry never runs out of, it is innovation. So, the FCC has to winnow out the innovative ideas that have no practical application to its spectrum allocation plans from those that fit nicely into its existing schedule.

At the core of the problem are technological and marketplace forces that cannot be reconciled with regulation and spectrum scarcity. New ideas push out old ideas and equipment. The faster that technology moves, the faster the old equipment becomes obsolete, thereby causing a problem for people who bought older equipment and have not yet amortized their investment.

Marketplace havoc

Despite the benefits that result from its

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Regulating technology

introduction, new technology can cause havoc in the marketplace. (Consider the effect that cellular radio has had on the Improved Mobile Telephone Service). A service quickly can be reduced to a virtual shell when new services drain off a substantial share of customers. What responsibility does the FCC have to the operators of the older service? Should it be savior or executioner? Should it be pro-progress or "pro-tector" to entrenched interests?

The problem becomes even more muddled when other agencies, such as the Department of Defense (DOD), promote a technology so it can be used by the military. Soon, the DOD is enjoying its advantages, but the U.S. public cannot. For example, there was a long delay between the exploration of spread-spectrum modulation for secure military communications and its use in the civilian sector. Now spread-spectrum is in the civilian market, operating at the 902MHz-928MHz band, but "new" innovations in vehicle-tracking devices are pushing it off that band.

Advice for designers

There are as many or more forces running contrary to technological progress as

there are people promoting newer, better designs. For every new efficiency, there exists an entrenched interest that feels threatened and rebels against progress. At the beginning, designers must recognize this.

First, designers should consider the regulatory environment, including spec-

For every new efficiency, there exists an entrenched interest that feels threatened and rebels against progress.

trum allocation, prior to designing equipment. Second, consider the FCC regulations regarding emission limitations, such as bandwidth. A great design that cannot

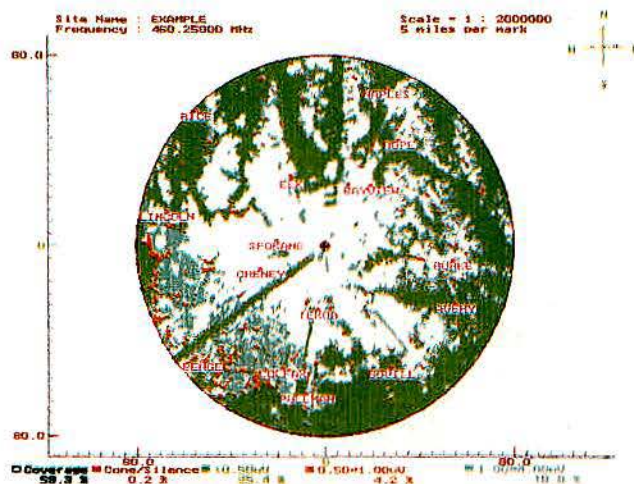
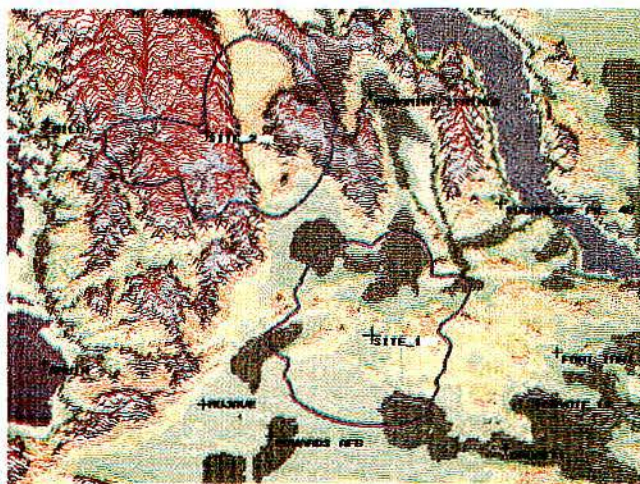
receive equipment authorization is of little commercial use. Third, consider the effect on the market. A simple improvement will meet less resistance than a technological revolution. Finally, for the truly sophisticated, some examination of the direction that the industry and its regulators are heading would be quite helpful. The cutting edge is defined by state-of-the-art technology and state-of-the-union politics.

Under no circumstances should the innovative designer be discouraged. The FCC is more flexible than it appears to be from reading its rules; nevertheless, it helps to take FCC employees into your confidence early on to determine what hurdles you might face before your device can get to market.

Remember, the FCC wants to help to bring new radio technology to the market. It is just that there are these associations and rules and congressmen and clubs and policies and preferences and committees and . . .



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SmartLink completes development of trunking radio switch

Engineers at SmartLink, Wallingford, CT, spent nearly three years developing a "protocol-and-frequency-transparent" radio switch and related circuitry and computer software for private and public radio systems, such as trunked networks and specialized mobile radio (SMR) systems. Mark Hatten, the company's managing general partner, said that the development is complete, and several switches have been installed in operating systems.

Protocol transparency means that a radio system's repeaters can be used to relay signals using the GE MarcV, GE MarcVE and Johnson LTR trunking protocols, re-

gardless of which protocol the repeaters originally were configured to use. With a protocol-and-frequency-transparent switch, system operators can use mobile and portable units from a variety of suppliers regardless of trunking format. The switch also allows conventional (non-trunked) radios to use a trunked system repeater.

The company plans to support the Motorola Privacy Plus and Philips MPT1327 trunking protocols in the future, but it does not plan to support the Midland CMS trunking protocol.

Pittencrieff Communications acquires assets of two SMR operators

Pittencrieff Communications, Abilene, TX, has completed the acquisition of the SMR assets of Knight's Communications, Fort Worth, TX, and Contact New Mexico, Albuquerque, NM.

The acquisition of Knight's Communications provides Pittencrieff with two more sales and service centers, located in Fort Worth and Dallas and a total of 125 exist-

ing SMR channels in the Dallas/Fort Worth area.

The acquisition of Contact New Mexico's 37 SMR channels strengthens PCI's SMR market leadership position in New Mexico and expands the company further into Colorado.

The two acquisitions add 2,000 new subscribers to PCI's customer base.

Communications managers form EGE trunked users group

A group of communication managers responsible for the operation and management of Ericsson GE Mobile Communications (EGE) trunked radio systems has formed a users association to exchange information among members relative to EGE Enhanced Digital Access Communications System (EDACS).

The group is open to all users, including commercial owners of GENET 900 systems.

The organization was formed to provide a forum to exchange information among members relative to the implementation, operation and maintenance of their EGE digital trunked radio system; to relate collective hardware and software problems to EGE for resolution; to request features and enhancements to existing EGE trunked radio systems; and, by mutual cooperation with EGE, to provide information on current and future products and services.

For more information about the users group, call Max E. Grigg, vice-chairman, 602-870-6755.



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Reader's choice

Of all the new products and services in the July 1993 issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Spread-spectrum radio modem does not require FCC operating license

The NLR-96 radio modem from **Repcos** uses spread-spectrum radio modulation and does not require an FCC license. The NLR-96 connects directly to any RS-232 data source and transfers data. Two interface modes are RTS/CTS

handshaking and a three-wire direct connect. The modem can be configured for synchronous or asynchronous operation and is available in 120/240Vac or 12Vdc versions.

Circle (500) on Fast Fact Card

Two-way radio and field-programmable repeater extend product line

Motorola has expanded the Radius line with the GM300 mobile two-way radio and the GR300 repeater. The GM300 is available in 8- and 16-channel models, VHF and UHF frequencies, and is dash- or remote-mount capable. It features 1W-25W of variable power, with as much as 45W of fixed power on selected versions. The 16-channel model provides Quik-Call II, MDC-1200 and DTMF signaling formats. The unit meets

MIL-STD 810 C, D and E military specifications.

The GR300 repeater is composed of two GM300 mobiles, duplexer, metal enclosure with temperature-controlled fan, repeater interface communications kit, power supply and cables. The repeater is field programmable with desk-top control point operation.

Circle (501) on Fast Fact Card

Canvas cases resist mildew, stains



Leathersmith offers a line of canvas carrying cases for all popular two-way radios and pagers. Made of Propex III canvas, the cases resist mildew, stains, oil and most chemicals. Logos are imprinted at no charge.

Circle (502) on Fast Fact Card

Pager is designed as wrist watch

The Receptor MessageWatch from **Seiko Telecommunication Systems** contains a tiny FM receiver and antenna. Transmission options include 16-digit phone numbers, standardized messages and a dual-zone time system.

Circle (503) of Fast Fact Card

KEEP IN TOUCH at the pump

Weather-proof cap removed (at right) to reveal connection for optional MAG-EXPT extension module, which adds 25' of mobility to the MAG-PPR.



In response to numerous requests from firefighters, Telex has developed the MAG-PPR pump panel remote headset station. Designed for use with Telex under-helmet or other hearing protection headsets, the rugged, water-resistant MAG-PPR offers an inexpensive way to comply with OSHA rules and NFPA guidelines without investing in a complete intercom system. Because it allows the officer at the pump panel hearing protection as well as the ability to monitor the radio, firefighters using the MAG-PPR have reported reduced fatigue and improved communications. If desired, the MAG-PPR may be integrated with a Telex MAGNACOM™ intercom system. Call or write for more information.

TELEX

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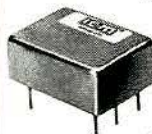
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New products

Reactive power divider affords low insertion loss, moisture protection

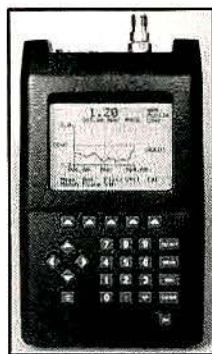
JFW Industries offers the model 50PD-091 reactive power divider. The divider features a moisture-proof finish and O-ring seals on all type N connectors and the enclosure cover. The frequency range is 800MHz-1,000MHz, with +0.2dB power asymmetry and RF input power rated at 10W average and 1,000W peak. The 50 Ω device has an insertion loss of +0.7dB (above 3dB split) and a phase balance of +3°.



Circle (450) on Fast Fact Card

Tester simplifies troubleshooting for mobile installers/base engineers

The AT-800 is a hand-held antenna tester for 800MHz cellular services from Bird Electronic. A built-in RF source is used for measuring VSWR, match efficiency and return loss at single frequencies. It also can automatically sweep over a user-specified frequency range. Numeric measurements and high-resolution graphic plots are displayed on an LCD. A serial interface and optional software can transfer stored measurements to a personal computer for storage and hard copy.



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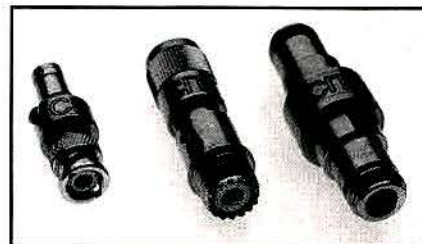
Circle (66) on Fast Fact Card

CD-ROM, floppy files expand use of FCC master frequency database

PerCon business and amateur radio license databases on CD-ROM and floppy disks include FCC master frequency database information that may be output to a screen, printer or file. Data comes in 20 formats. An access program allows for a browse mode of displays and use queries. FAA databases are expected to become available this year.

Circle (452) on Fast Fact Card

Coaxial surge protectors absorb many surges without degrading

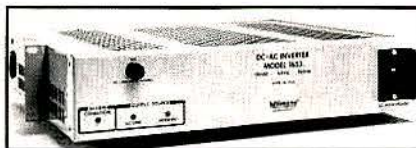


Citel America has unveiled a new line of coaxial surge protectors for coaxial cable used in mobile radio, radiopaging, cellular and microwave base stations. The protectors shunt excess electricity to ground and reset automatically after every strike. A special patented coaxial gas tube allows the protectors to absorb numerous surges without degrading. Protectors are available in VHF, BNC, F and N types. They maintain transmission characteristic impedance up to 2.5GHz.

Circle (453) on Fast Fact Card

Space-saving rack-mount inverter provides power supply versatility

The 500VA model 1653 rack-mount inverter from **Wilmore Electronics** occupies only 3½" of vertical rack space. The inverter has a 120Vac, frequency-stable, 60Hz, quasi-sinewave output. Standard versions operate with 24Vdc, 48Vdc or 130Vdc battery sources. The inverter can power not only sensitive telecommunications equipment but also difficult high-surge or nonlinear loads such as small

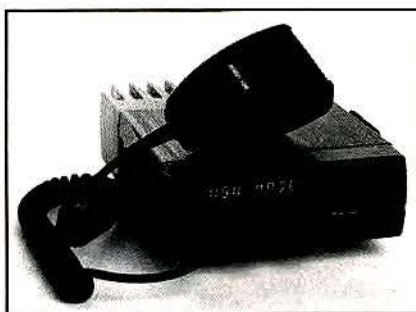


motors, switch-mode ac-dc power supplies or even half-wave rectified loads.

Circle (454) on Fast Fact Card

VHF mobile radio provides 15W-50W output in compact 6"×9" format

The EMH 599 0A is a 114-channel VHF mobile radio that may be programmed to operate on any frequency in the 136MHz-174MHz range without degradation in specifications. The dash-mount radio from **Bendix/King Mobile Communications** has an eight-character, 14-segment, vacuum-fluorescent, alphanumeric display. The radio is only 2"H×6"W×9"D, but its adjustable power ranges from 15W to 50W. Features include busy channel lockout and indicator, scan, priority scan, CTCSS, CDCSS, time-out timer, home channel revert, next scan channel and nuisance channel delete. The EMH is covered by a



five-year warranty at no additional charge.

Circle (455) on Fast Fact Card

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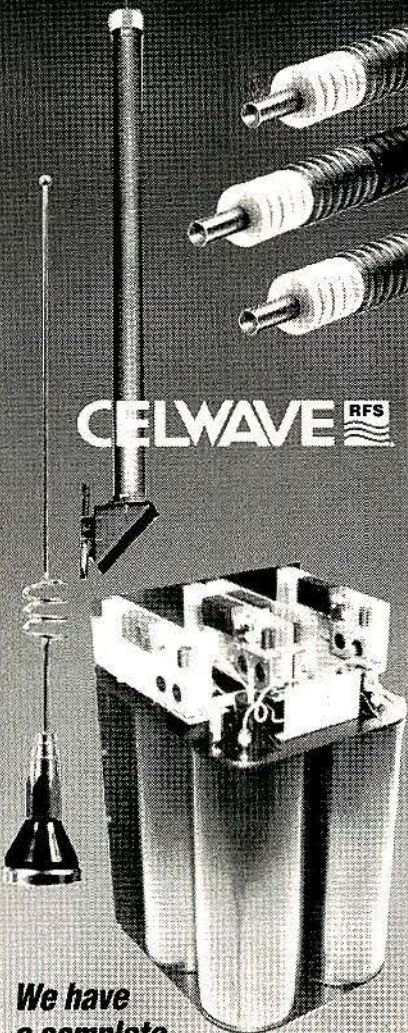
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SMR/Trunking

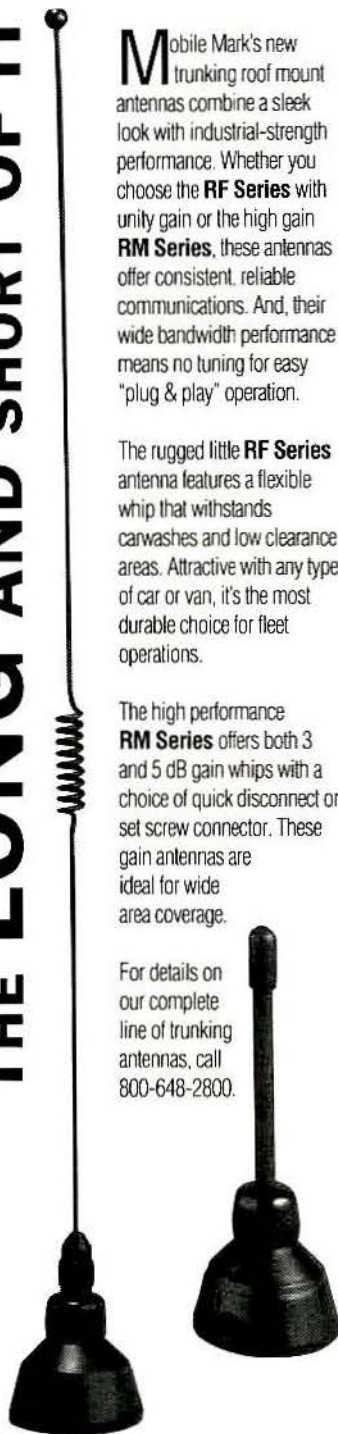
THE LONG AND SHORT OF IT

Mobile Mark's new trunking roof mount antennas combine a sleek look with industrial-strength performance. Whether you choose the **RF Series** with unity gain or the high gain **RM Series**, these antennas offer consistent, reliable communications. And, their wide bandwidth performance means no tuning for easy "plug & play" operation.

The rugged little **RF Series** antenna features a flexible whip that withstands carwashes and low clearance areas. Attractive with any type of car or van, it's the most durable choice for fleet operations.

The high performance **RM Series** offers both 3 and 5 dB gain whips with a choice of quick disconnect or set screw connector. These gain antennas are ideal for wide area coverage.

For details on our complete line of trunking antennas, call 800-648-2800.



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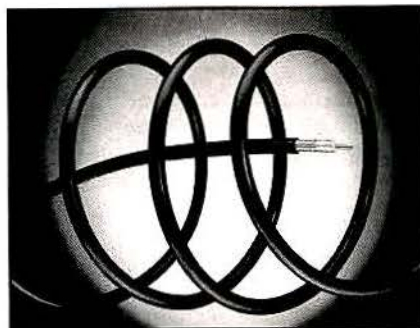
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Circle (94) on Fast Fact Card

New products

Flexible, weather-safe cable offers low attenuation, short bend radius

LMR-400 flexible communications cable from **Times Microwave Systems** has an attenuation of 3.9dB/100 feet at 900MHz and a diameter of 0.405". A 1" minimum-bend radius allows for easy installation in short antenna feeder, jumper and interconnection applications. The copper-clad aluminum center conductor is surrounded by a polyethylene foam dielectric and a tape and braid outer shield. A black polyethylene jacket provides weather protection. In addition to TMS connectors, the cable accepts connectors for several other makes of high-velocity, RG-8-type cables. LMR cables are available in diam-



eters from 0.24" through 1.67".

Circle (456) on Fast Fact Card

Benchtop battery charger provides quick charge without excessive heat

The New Generation Smart Charger combines negative delta voltage ($-\Delta V$) sensing circuitry with a redesigned switching power supply. This provides a faster charge in a



smaller unit without generating undesirable heat, suitable for benchtop applications. The charger, from **Alexander Batteries**, maintains full charge by automatically switching to a float charge to keep NiCd batteries charged and ready for use. The charger will charge 4V-15V NiCd batteries and can be made capable for nickel-metal hydride charging.

Circle (457) on Fast Fact Card

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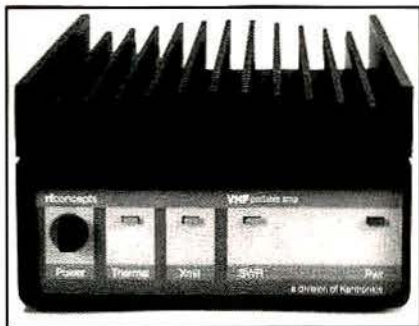
HCS Telecommunications (800) 346-6442

Circle (83) on Fast Fact Card

Self-protecting amplifier delivers as much as 50W of output power

With 1W-8W of input, the RF Concepts "VHFportable" amplifier delivers 50W of output power automatically. Features include a 3½-pound heatsink and thick casing for extended durability. A VHF discriminator eliminates false keying by out-of-band signals. Thermal sensing circuits cause amplifier shutdown at temperatures exceeding 131°F, and automatic level control circuits reduce power output when an antenna mismatch exists.

Circle (458) on Fast Fact Card



Digital paging transmitter provides low-power solution for institutions

RF Neulink introduces three models of a low-power digital paging transmitter for use in simulcast systems, hospitals, factories or security systems. Model DPT-150 is for VHF digital paging. Model DPT-450 is for UHF digital paging. Model DPT-900 is for 900MHz digital paging. The transmitters use a direct-coupled, non-return-to-zero modulation scheme for POCSAG and Golay paging systems. A built-in AFSK (up to 1,200 baud) demodulation is available as a modification for easy con-

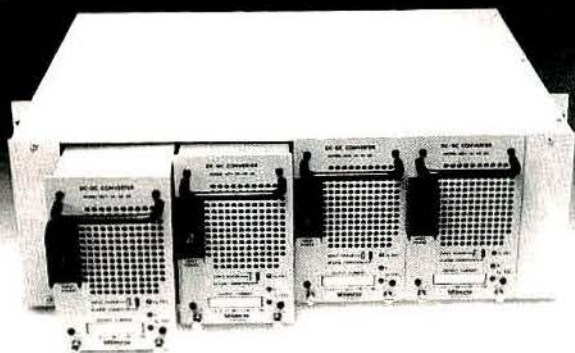


nection to an existing 72MHz (or other frequency) receiver link.

Circle (459) on Fast Fact Card

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Circle (69) on Fast Fact Card

New products

Military format frequency hopper becomes available for tactical use

Radio Systems has announced the availability of its PR8077 "Falcon" frequency-hopping radio for tactical operations. The submersible hand-held is available in the 60MHz–88MHz subband in $\pm 10\text{kHz}$ transmit deviation format. Additional subbands are forthcoming in the range between 30MHz and 108MHz. The PR8077 is designed for low-intensity conflict operations when avoidance of detection by receiver scanners and resistance to single-channel jamming is desired. The radio is clear-voice compatible with AN/PRC-77 manpack-type tactical radio equipment. A Transcript International SC460-format encryption option is available for secure single-channel operation. Power output is 1W or 5W, user-selectable.



Circle (460) on Fast Fact Card

Trunked radiophone introduces full-duplex interconnect capability

The PFD 3000 from **Motorola** is a private trunked systems portable radiophone that combines half-duplex dispatch operation with full-duplex telephone interconnect capabilities. The radiophone operates on Motorola's 800MHz Smartnet private trunked radio systems. It has a standard two-line LED display and can be used in wide-area or single-site systems. Dispatch radio features include Private Conversation, Call Alert, multiple talkgroups and systems, dynamic regrouping, emergency alarm and call, and scanning. Telephone capabilities include full-duplex telephone interconnect, telephone interconnect receive, local or long-distance calling, and last number redial.

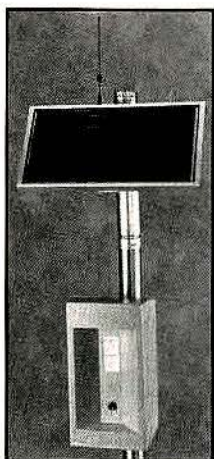


Circle (461) on Fast Fact Card

Emergency communication station uses cellular or trunking systems

Technology Service Group has introduced an Emergency Assistance Cellular Phone System for public roadways and emergency communication applications. Configurations are available for most wireless technologies in use and follow all CCITT, FCC and Bellcore signaling specifications. The power source is 12Vdc, 2.5A maximum, for cellular and 6A for trunking systems; a solar panel assembly is an option. Transceiver output power is 3W cellular and 12W ERP for trunking systems. The operating frequency range is 806MHz-960MHz.

Circle (462) on Fast Fact Card



Transmitter controller maximizes airtime, reuses existing resources

The GL-C2000 transmitter controller from Glenayre provides paging operators with high-speed capabilities to maximize airtime. Features include no required airtime to synchronize the system, automatic remote system upgrades, forward error corrections, Global Positioning System (GPS) timing and channel sharing. Beginning at the paging switch and continuing throughout the system, the GL-C2000 reuses many expensive resources such as links, phone lines, modems and real estate.

Circle (463) on Fast Fact Card

TNPP network controller delivers high throughput for radio paging

Real Time Strategies has released its Advantage-Express/TNPP Hub, its highest throughput TNPP network control and traffic accountability system for radio paging networks. The networking system is capable of processing as many as 1 million packets per hour per Hub module. The Hub provides network monitoring, traffic validation, statistical reporting, subscriber call counting, dedicated and dial up TNPP, multi-link load sharing/load balancing, automatic alternate routing around troubled links, optional subscriber roaming, and subscriber initiated lost message retrieval.

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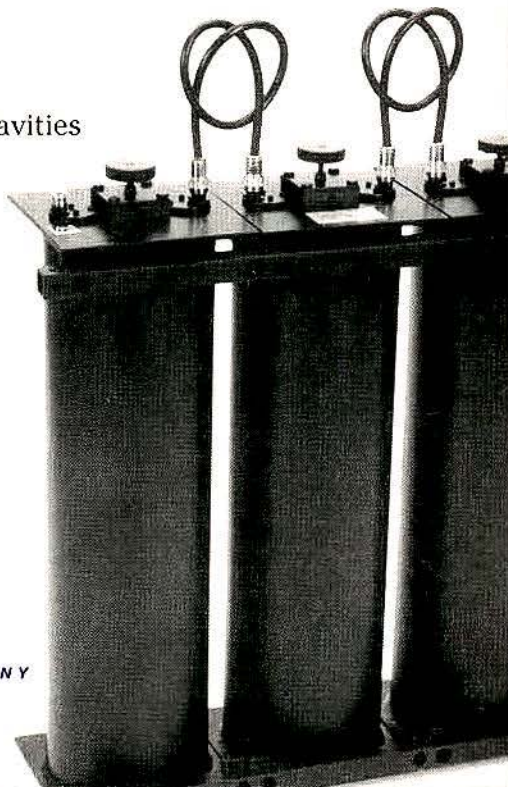
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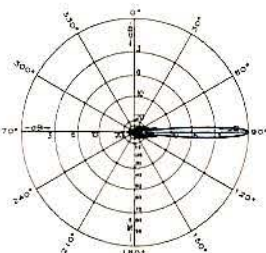
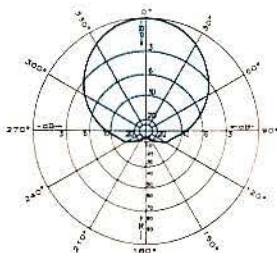
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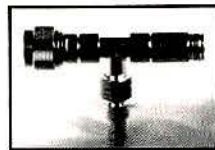
Circle (75) on Fast Fact Card

New products

Signal sampler performs as three-port, in-line device

RF Industries introduces its Unidapt RFA-4059-A and RFA-4059-A1 signal samplers. Essentially a three-port, in-line device, the top of the "T" comprises the in-line device with removable Unidapt connectors. The RFA-4059-A comes with one male and one female connector that are replaceable with UHF, BNC, TNC, mini-UHF or SMA Unidapt male or female sections. The bottom of the "T" is an adjustable BNC female tap with attenuation of 20dB-80dB. The device allows connection to either a transmitter, a receiver with full termination, or transceiver input or output. This allows tapping of power for test purposes or injection of signal generator output for noise measurement. The sampler can be permanently left in the antenna line for occasional tests or for an RF power failure alarm. The RFA-4059-A1 is supplied without the N connectors for users who already have an RFA-4024 Unidapt kit.

Circle (465) on Fast Fact Card



Compact scanner comes in 40W VHF, 25W UHF models

The Mini-Com Plus SM series provides 16- or 99-channel scanning capability in the most compact scanning mobile radio offered by Relm Communications. The SMV40 version is a 40W VHF (150MHz-174MHz) unit. The SMU25 is a 25W UHF (450MHz-482MHz) unit. Both radios measure 1 1/2"H x 5 3/4"W x 7"D. The SM series features automatic squelch and built-in CTCSS and DCS.

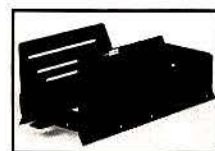
Circle (466) on Fast Fact Card



Mobile console accommodates a variety of equipment

SMC Electro-Mount adds its model VCC-E to its line of custom-designed mobile communications consoles. The VCC-E accommodates the installation and positioning of a variety of equipment, including two-way radios, control heads, siren and lightbar controls, mobile telephones and mobile data terminals. Properly installed, the VCC-E is "airbag zone" compatible.

Circle (467) on Fast Fact Card



Mexican topographic data allows comm system design

SoftWright announces the availability of digital elevation data for the entire Republic of Mexico. The files are configured to operate with SoftWright's Terrain Analysis Package software to allow optimum design of land mobile radio, paging, cellular and microwave radio systems, including RF coverage, site selection, and antenna selection and orientation. This capability allows system designers to view proposed transmitter sites with 3-D computer modeling and make detailed predictions of performance, ranging from excellent to substandard from proposed systems.

Circle (468) on Fast Fact Card

Decoder simultaneously reads CTCSS, DCS, DTMF signals and displays tone and character information

The Model DC440 communications decoder from **Optoelectronics** reads 50 subaudible (CTCSS) tones, 106 digital (DCS) tones and 16 Touch Tone (DTMF) characters simultaneously. Applications include two-way communication test, repeater monitoring, updating older service monitors, enhancing recreational monitoring, as well as security and surveillance monitoring. Model DC440 monitors the demodulated audio output from a communications receiver, service monitor, scanner or interceptor. Tones, codes and characters detected are displayed on a two-line, alphanumeric LCD. A serial data jack permits connection to a PC serial port for remote operation.

Circle (469) on Fast Fact Card



MAS radios offer over-the-air adjustments, diagnostics

Fully synthesized master and remote 900MHz Multiple Address System (MAS) radios with over-the-air adjustment and diagnostic testing capability are available from **Alligator Communications**. Alligator diagnostic software is loaded into a PC, which is connected to a master station. This makes the remotes accessible for monitoring and adjusting via the radio's RF path. Users can fine-tune transmit/receive frequencies, adjust RP power output, and enable and disable PTT-VOX-AFC together with other operations.

Circle (470) on Fast Fact Card



Right-angle coaxial plugs require no soldering or cap

A right-angle coaxial plug design from **Radiall** eliminates the need for soldering at the internal center contact point or installation of an access cap. The right-angle connection is permanently made inside the plug body. A separate contact on the center conductor of the cable is used for the cable-to-center contact connection. Installation requires only the stripping of the cable end, crimping or soldering the separate contact to the center conductor, pressing on the plug and crimping the jacket to the plug body. Proper mating of contacts is accompanied by an audible "snap."

Circle (471) on Fast Fact Card



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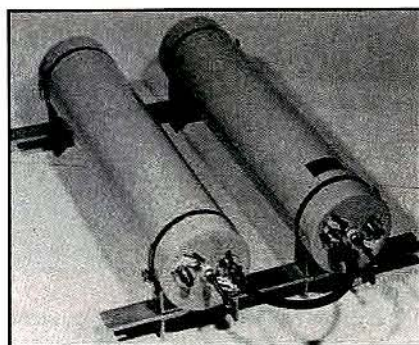
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Mark Antennas Division

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Tel 708-298-9420 Fax 708-635-7946

Circle (77) on Fast Fact Card

New products

Bandpass cavities protect against transmitter interference, radiations



Three models of 5" bandpass cavities for operation from 118MHz to 174MHz are now available from **Telewave**. The cavities are used in frequency-congested areas to provide protection from transmitter intermodulation interference, transmitter spurious radiations and receiver desensitization. Model TWPC-1505 is for use in highly congested RF environments. Model TWPC-1505-2 dual cavity (shown) and Model TWPC-1505-3 triple cavity provide additional protection for more severe RF environments.

Circle (472) on Fast Fact Card

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Circle (78) on Fast Fact Card

Belt radio incorporates attributes for hostile, high-noise environments



The series 4B Belt-Pak radio from **Earmark** is engineered for people working in hostile environments, high-noise areas and for personnel wearing protective clothing or working in confined spaces. The 4B has a quick-disconnect Nexus connector as the headphone attachment mechanism and sealed switches. Controls have been relocated to prevent accidental actuation. The receive antenna is fully enclosed in the Belt-Pak case, and a non-removable, 12" trailwire replaces the original transmit antenna.

Circle (473) on Fast Fact Card

Triple omni antenna offers solution for diversity receive applications

Decibel Products' new triple omni DB805TR-Y encloses, in a single radome, three base antennas, each with 4.4dBd gain (6.5dBi). The frequency range for receive is 890MHz-915MHz; for transmit, the range is 935MHz-960MHz. Constructed with a receive antenna above and below a middle transmit antenna (Rx/Tx/Rx), the DB805TR-Y is suitable for applications with diversity receive. The VSWR for transmit is 1.4:1; for receive, 1.5:1. Isolation between adjacent antennas is 36dB.

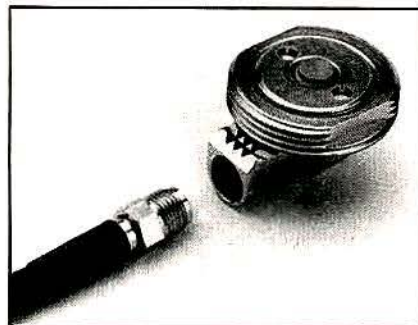
Circle (474) on Fast Fact Card



Mobile antenna provides shielding against interior radiation hazards

The MCA 2000 NMO mobile antenna mount from Richard Hirschmann of America features full shielding against interior radiation. The fully plated forged brass mount has a constant impedance FME connector for a precise match to feed line and improved performance at high frequencies. The mount is suitable for all land mobile frequencies from 25MHz-1,000MHz and can handle up to 150W.

Circle (476) on Fast Fact Card

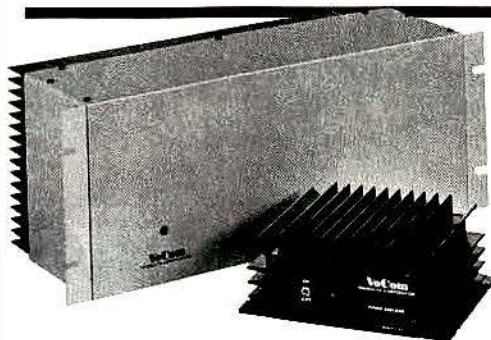


Rugged environmental needs prompt lowband hand-held's design features

The RTX-050 synthesized lowband portable is designed for demanding applications. It has a rugged uni-body housing made of polycarbonate plastic and sealed operating controls to protect against dust, dirt and moisture. The RTX-050, an addition to Ritron's Patriot line of two-way radios, features 11-channel capacity, 5W output power (programmable to 2W), normal or priority scan, CTCSS, DCS, two-tone sequential and low battery alert. Models are available for 29.7MHz-36MHz, 36MHz-42MHz and 42MHz-50MHz.

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Circle (84) on Fast Fact Card

Low Loss ...

LMR™-1200 cable is your best choice for paging, cellular, PCS and two-way radio fixed antenna feeders. Compared to 7/8" corrugated copper cables, LMR-1200 provides comparable loss and greater flexibility at a lower price. Its weatherproof, durable construction is based on proven CATV cable technology.

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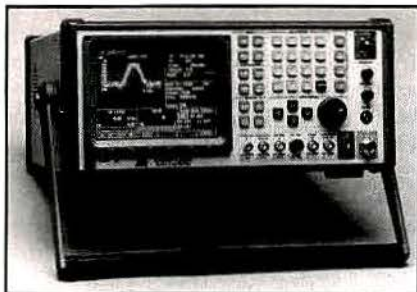
Circle (80) on Fast Fact Card

New products

Monitor offers split-screen analyzer, high-resolution electron lens display

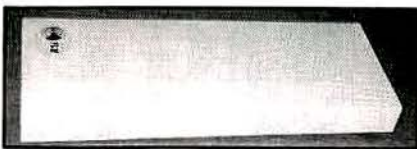
IFR Systems' COM-120A service monitor, with crossband duplex, split-screen analyzer and high-resolution electroluminescent display, has the measurement resources to maintain most conventional wireless systems. The RF generator and receiver screens display all pertinent UUT information plus a simultaneous scope or spectrum analyzer. The unit comes equipped with encoding and decoding circuits for CTCSS, two-tone sequential, DCS and DTMF signaling.

Circle (477) on Fast Fact Card



Expanded flat panel antenna line meets SMR, GSM, SCADA, cellular needs

Radiation Systems' Mark Antenna Div. introduces three low-profile, flat panel antennas with 18 possible configurations for communication needs among SMR, GSM, SCADA and cellular users. Operating in the ranges of 806MHz-866MHz, 820MHz-925MHz and 870MHz-960MHz, these antennas are manufactured in 83° and 105° horizontal beamwidths. Gain ranges from 8.0dBd to



11.5dBd. The three models, FP-824, FP-936 and FP-1148, also may be ordered with electrical downtilts of 5°, 10° or 15°.

Circle (478) on Fast Fact Card

Two-way UHF hand-held combines compact size with full power output

The EasyTalk UHF-50 from Nady Systems operates in the 450MHz-470MHz band and has one standard installed channel and four-channel capability. The unit weighs 16 ounces and delivers 5W of output power, selectable to 1W. The radio comes with a flexible UHF antenna with a BNC connector, an ac-dc battery charger, belt clip, carrying holster and an 11V NiCd rechargeable battery pack. Options include CTCSS, remote speaker-mic, high-speed charger and a leather case.



Circle (479) on Fast Fact Card

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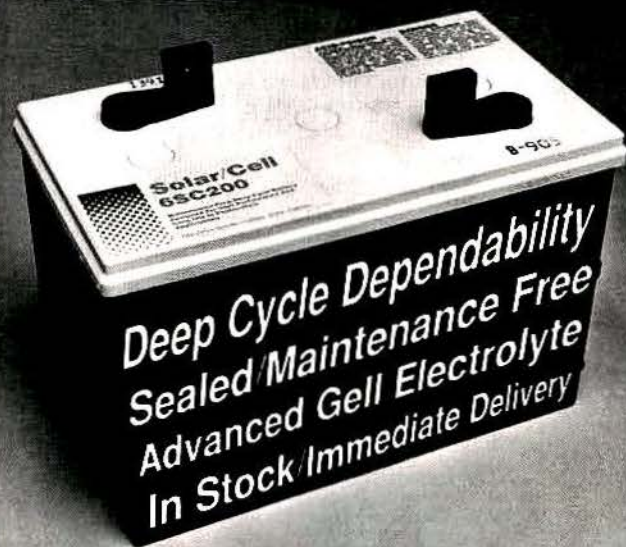
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Circle (82) on Fast Fact Card

Deoxidizing/conditioning chemicals improve conductivity characteristics



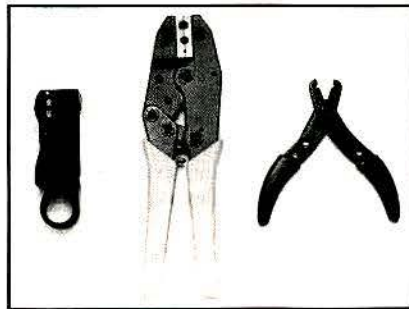
Pro-Gold is a nonabrasive and noncorrosive conditioner and preservative for gold edge connectors, cables, plugs, switches and relays. The conditioner enhances conductivity characteristics to more efficiently transmit electrical signals. The treatment provides protection from abrasion, arcing, tarnishing and atmospheric contamination. The **Caig Laboratories** product is available in spray, liquid, precision dispenser, wipe and pen applicator forms.

Circle (480) on Fast Fact Card

Tool series for cellular installation includes stripper, ratchet crimper

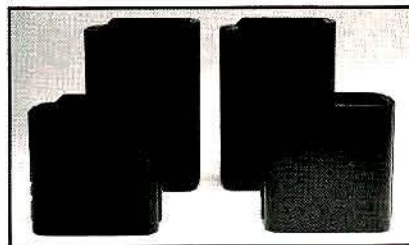
Advanced Fox Cellular introduces three installation tools for cellular phone installers. The ratchet crimper crimps any type of connector with center pin to RG58 or RG59 coaxial cable. The rotary coaxial cable stripper allows the user to strip the coaxial jacket and inner conductor in one operation. The wire cutting and stripping tool comes with an adjustable screw controller for stripping wire from sizes 10AWG to 30AWG.

Circle (481) on Fast Fact Card



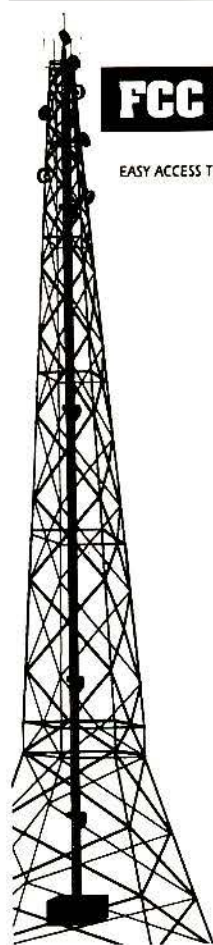
NiCd replacement batteries become available for two major radio lines

Centurion's 10.8V NiCd replacement batteries for two major manufacturers' radios are now available. The Centurion model MS1155 (standard capacity) is the replacement for the Maxon model SA-1155 radio. The Centurion model MS 1165 (high capacity) is for the Maxon model SA-1165 radio. The Centurion model MG-5061 (standard capacity) is the replacement for Ericsson GE model 344A4506P1 radio. Centurion's model MG-5063 (high capacity) is the replacement for the



Ericsson GE model 344A4506P3 radio.

Circle (482) on Fast Fact Card



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FCC Administrative Tracking Information

Amateur

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Circle (85) on Fast Fact Card

Police/Fire Comparator Display			
East Police	West Police	Central Police	Imperial Police
Indian Hill	Miami Heights	Williamson Rd	Comm Center
Williamson Rd	Calhoun Hall	Greenhills	Indian Hill
Glendale W.T. Rd	Cheviot	Engineers	Miami Heights
Comm Center	Comm Center	Glendale W.T.	Calhoun Hall
Loucland W.T. Rd	Mt. Echo	Calhoun Hall	Greenhills
Sweetwine	Miami WW	Comm Center	Loucland W.T.
Anderson Tap	Greenhills		Mt St Joseph
Greenhills Vote	Cleves		Sweetwine
Engineers	Fernald		Miami WW
Millford	Prov. Hosp.	Fire Channel 01	Glendale W.T.
Baricourt	Mt St Joseph	Repeater Ctrl Dis	Marionmont
Calhoun Hall	Engineers	Comm Center	Millford
	Miamitown	Fire Channel 02	Cheviot
	Harrison	Fire Channel 03	Miami Heights Vote
		Calhoun Hall	Williamson Rd
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			Mt. Echo
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Remote Comparator Display

The Smartswitch II™ Remote Comparator Display monitors and controls voting receiver systems on a personal computer or console. It can be used locally or remotely with leased-line or dial-up modems.

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Circle (86) on Fast Fact Card

New products

Software integrates two-way radio with computer, vehicle location tech

The MDCOM-101 RF data communication network software package integrates two-way radio function with computer and/or vehicle location software as a low-level, user-configurable platform. The software from **Data-Air Technologies** supports mobile data and point-to-point applications in the DOS, Windows, OS/2,

Unix and IBM 3270 environments. The MDCOM-101 driver is designed to sustain 100% error-free file and data transfer between base station and multiple mobile units on any two-way radio network in either conventional or trunking repeater formats.

Circle (483) on Fast Fact Card

Microprocessor-controlled repeater features message recorder module

The Model REP-200T microprocessor-controlled repeater with a DVR-3 digital voice recorder module from **Hamtronics** is FCC type-accepted for operation in the commercial VHF highband and UHF band. RF power output ranges from 10W to 25W, depending on frequency. Add-on power amplifiers are available for increased output up to 100W. The recorder records and plays back messages over the air under DTMF control. Model REP-200C uses a COR-6 controller module with voice ID but no DTMF decoder or interconnect.

Circle (484) on Fast Fact Card

Miniature soldering iron puts heat directly under tip for precise work

M.M. Newman introduces the Antex model C, a high-efficiency soldering iron that accommodates a variety of slide-on tips, including a hot knife tip. The Antex model C has a pencil-thin handle for precision control and has its heating element located directly under the tip for optimum thermal efficiency. The nickel-plated, copper alloy tips include a conventional spade, chisel, stubby, needle, pyramid, cone and the hot knife. Heating up to the operating temperature of 700° takes 45 seconds.

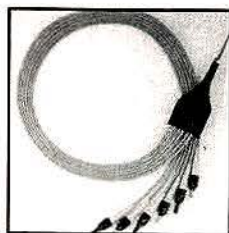
Circle (485) on Fast Fact Card



Breakout router permits furcation of optical fibers into separate tubes

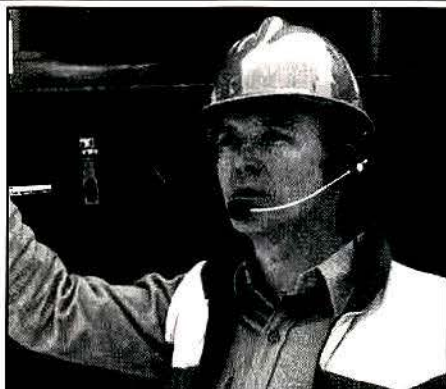
A fiber-optic breakout router is available from **Automatic Tool & Connector**. The router allows bundles of as many as six fibers to be directed into individual furcation tubes. Each tube snaps securely into the router housing. The inner tubing, Kevlar and outer jacket of the furcation tubing are bonded together to prevent movement during and after the termination process.

Circle (486) on Fast Fact Card



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Universal car kit works with a variety of portable cellular phone models

CellPort Labs has announced a universal car kit for the cellular industry. The model 9301 kit can be used with a variety of portable cellular phone models. The

9301 is designed to accommodate future phone designs and to prevent kit obsolescence when a user wants to upgrade phone models. Features include hands-free operation, a head-set interface, an external antenna connector, and a connection for powering the phone and charging the phone's battery pack. The kit will accept both single- and dual-mode cellular phones.

Circle (487) on Fast Fact Card

Wireless remote monitoring system uses cellular phone to link site, user

Remote Monitoring of America announces the RemoteLINQ system for remote monitoring. The RemoteLINQ includes a microprocessor and stored logic, interfaces for sensors and a communications interface for either a cellular phone, a land line or both. When sensors detect an aberrant condition, the system sends a digital message back to the owner's corporate or personal computer, and/or broadcasts an alphanumeric pager message.

Circle (489) on Fast Fact Card

Panel antenna lessens tower loading

The Americell AP8-850/105 panel antenna is designed for fixed-station applications in the 806MHz-894MHz band. The antenna, from Scala Electronic, features smaller size and weight (for less tower loading), silver-plated copper dipoles, an alodined aluminum backplate and fiberglass radomes. Dimensions for the 6.7-pound panel are 26"Hx10"Wx4"D. The antenna has a VSWR of less than 1.3:1 and a gain of 8.5dB referenced to half-wave dipole.

Circle (488) on Fast Fact Card



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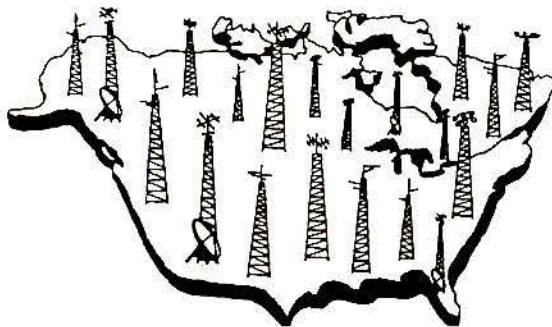
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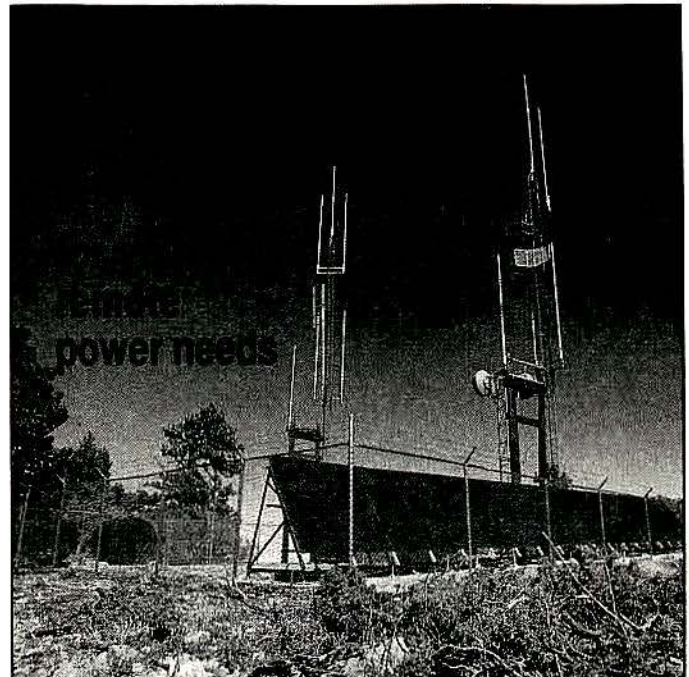
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Return Loss Bridges

Low Cost Swept SWR

Return Loss Bridges offer a low cost solution for swept SWR measurements to 3.0 GHz. These bridges extend your spectrum analyzer/tracking generator or service monitor capabilities. Antenna and cable swept measurements are quick and easy. Five watt power rating, unmatched in the industry, insures durability. Solid nickel plated brass case survives in field environments.

FREE app note, "High Performance VSWR Measurements", discusses uses and techniques for return loss bridges!

Model	Freq Range MHz	Directivity	Price
RLB150N3B	5 to 1000	45 dB	\$389.00
RLB150N3C	5 to 1300	45 dB	\$425.00
RLB150N5A	5 to 3000	40 dB	\$579.00

Accessories: Eagle also manufactures the following:

Coaxial cable jumpers: low loss and individually swept.

RF termination: Used to check bridge performance.

Call or write for application note and brochure describing EAGLE return loss bridges and accessories.

EAGLE

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Circle (92) on Fast Fact Card

People



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Walsh



Bastian



Marvin

James Phillips, president of U.S. operations for Telular, Memphis, TN, advances to vice chairman.

James T. Walsh, sales director for TeleSciences Transmission Systems, Bloomingdale, IL, advances to vice president of sales.

Changes at Allen Telecom Group, Cleveland:

Dale Bastian departs Rose Communications, Santa Clara, CA, as director of sales to become vice president of North American sales for Allen Telecom Group.

Costel Matei, technical service and support engineer, advances to international systems engineer, Latin America.

Cloyd E. Marvin leaves Rugged Digital, Sunnyvale, CA, as president to become president of Peninsula Engineering, Sunnyvale, CA.

Reed E. Hundt exits Latham & Watkins, Washington, DC, as senior partner to become FCC chairman. Commissioner Ervin S. Duggan resigned effective Jan. 31 to become president of the Public Broadcasting Service.

On Dec. 3, 1993, MobileMedia, Ridgefield Park, NJ, acquired Metromedia Paging Services in Ridgefield from Southwestern Bell, St. Louis, and Metromedia Paging was renamed MobileMedia Communications.

R. Craig Roos, president of Local Area Telecommunications, adds to his responsibilities by becoming MobileMedia's chairman. **Charles J. Payer Jr.** exits Liberty Transnational as president to become MobileMedia's vice chairman.

Randall J. West joins MobileMedia as vice president of technology. **Gene P. Belardi** departs Southwestern Bell as vice president and general attorney to become MobileMedia's vice president, regulatory counsel and secretary.

Changes at Subscriber Computing, Laguna Hills, CA:

Steve Garrett leaves Information Complex Group, Redondo Beach, CA, as new business sales and marketing manager to become a client management consultant with Subscriber Computing.

Kathy Wyluda, quality assurance technician, advances to quality assurance manager.

Lindsay Houston exits Argus Business, Denver, as national accounts manager to join Telular, Memphis, TN, as director of marketing communications.

Travis Nelson moves up from production manager to become president of CTI, Corinth, MS, replacing **Jim Tucker**, who leaves the company to pursue a new position in the import and export of telecommunications products. Meanwhile, Tucker remains on the company's board of directors while acting as an adviser and consultant.



Little

Priebe

de la Rosa

David Little departs Decibel Products, Dallas, as an engineer to become systems engineer for Cartwright Communications, Cincinnati.

Louis V. Priebe leaves the Salt Institute, Alexandria, VA, as public policy director to join the Industrial Telecommunications Association as executive director of marketing and public relations.

Changes at LeBlanc Communications, Dallas:

Richard E. Elliott Jr. exits Microwave Networks, Houston, as director of sales to join LeBlanc as sales manager in Dallas.

Martin de la Rosa, P.E. leaves Falcon Steel, Fort Worth, as vice president of engineering to join LeBlanc as director of engineering.

Carla S. Culley, CPA departs Williams & Co., Sioux City, IA, as audit manager to become controller for LeBlanc, working out of Sioux City.

Steven W. Richards leaves Schaeff, Sioux City, IA, as quality assurance manager to join LeBlanc as quality assurance manager in Sioux City.



Stover

Trott

Bishop

Recipients of awards presented Nov. 19, 1993, at the Radio Club of America's Annual Dinner and Awards Presentation include:

Jerry S. Stover, P.E., who received the Fred M. Link Award for significant contributions to the development and advancement of land mobile communications. Stover, who retired as chairman of Communications Industries, Dallas, in 1980, serves as a volunteer assistant to the dean of engineering at Southern Methodist University and as a member of the Voice of America's Radio Engineering Advisory Committee.

Raymond C. Trott, P.E., who received the Special Services Award for outstanding contributions to the success of the Radio Club of America. Trott is the president of Raymond C. Trott Consulting Engineers, Dallas, and a member of MRT's editorial advisory board.

Don Bishop, who received the President's Award in recognition of his contribution to the success of the Radio Club of America. Bishop is the editorial director of *Mobile Radio Technology* and *Cellular & Mobile International* magazines, and the co-editor of *Proceedings of the Radio Club of America*.



FEEL APPEAL

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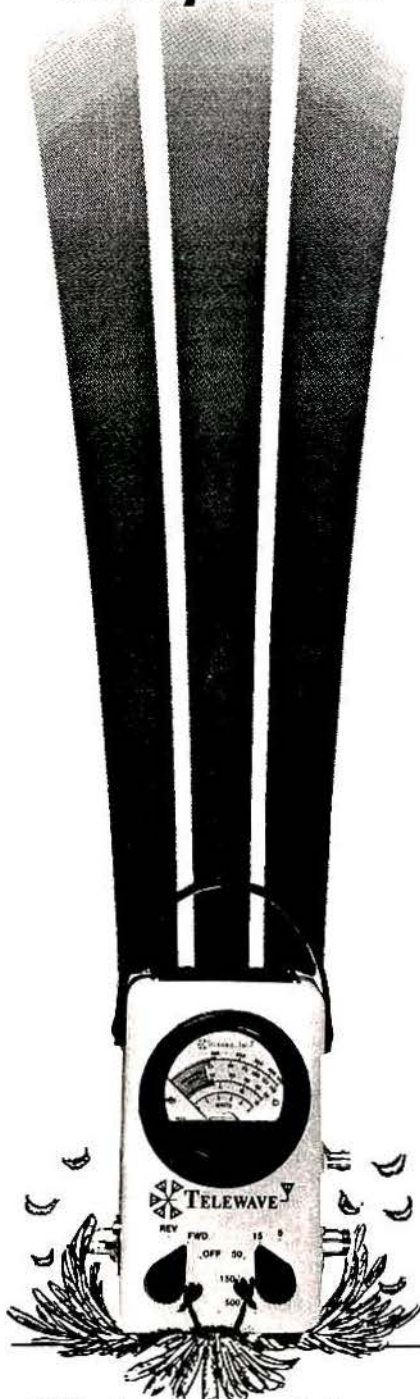


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Telewave, Inc.



Circle (96) on Fast Fact Card

L etters from readers

Radiating coaxial cable:

I read with great interest James J. Ford's article, "Improving Indoor Communications With Radiating Coaxial Cable" in the October 1993 issue, because, unbeknownst to me, Kaval Electronics seems to have been a contributor to the experiment.

Early in 1992, Times Microwave Systems approached me to evaluate the pros and cons for the two systems that the article calls "point source" and "radiating cable." We refer to the point source as the "tapped radiator." To conduct this experiment, we sent Times our antenna taps, antennas and VHF On-Frequency Radio (OFR) repeater. The intent was to carry out the evaluation by retransmitting the VHF continuous weather broadcast. The Kaval-supplied signal taps and antennas were all for 162MHz operation.

Because Kaval did not participate in the actual testing, it is surprising to us to learn from the article that the tests were conducted at 900MHz with equipment intended for VHF. Perhaps this explains the test results, which are contrary to our actual experience of having installed tapped radio systems in the Wake County (NC) Public Safety Building, the Milwaukee Jail and elsewhere.

The radiating efficiency of a dipole antenna is significantly greater than that of radiating cables where the radiating efficiency depends on the cable's surface wave. A test performed by R.A. Isberg, P.E., an underground communications consultant, compared signal strength from a slotted, half-inch Radiax radiating cable vs. a quarterwave whip antenna on a ground plane at 452MHz. Isberg concluded that for the same power as in the cable, the whip antenna (a monopole) had an average 30dB advantage of received signal compared to Radiax radiating cable.

Note: In the case of the tapped dipole, this received signal value is reduced by the tap's coupling loss from 10dB to 16dB.

Mr. Isberg's measurements have been confirmed by our company's experience with in-building system installation where a radiating cable in the vertical rises simply did not work.

Mr. Ford should have used only a single monopole antenna for his test, because it would have covered the entire test area. The use of two antennas, therefore, was detrimental to RF coverage as far as the point-source design was concerned.

As for the article's statement regarding the difficulty of installing point-source equipment, Kaval has developed a special tool to cut an access hole into solid-shield cable. Tap installation takes only five minutes. A radiator can be attached directly to the tap, or a ground plane typically can be

placed on a false ceiling. The taps have been standardized for 75Ω and 50Ω Trilogy air-dielectric half-inch cable, which is very light and easy to handle.

The 300-foot test section mentioned in Mr. Ford's report is, we assume, half-inch 50Ω cable, and if so, the cable loss is 6.96dB. Add to that a 2.1dB loss for the three taps, and the total loss for the test section is 9.06dB, rather than 19.4dB as shown in the report. This calculation assumes the use of Trilogy half-inch cable with the proper signal taps.

Based on our experience, there are many factors to consider when deciding on a method for in-building or tunnel radio design. We at Kaval are responsible for actual installation and use both the tapped radiator and radiating cable.

For in-building distribution, it is hard to beat the tapped radiator. For tunnel coverage, some of the advantages of radiating cable advocated by Mr. Ford become apparent. In all cases, it is hard to beat the cost of air-dielectric CATV cable at 70 cents per foot.

Still, some people like the reputation and proven performance of a company that has been in the business a long time, and they will not be swayed by something new.

Because not many people understand the tapped radiator concept, we have produced application notes for its use. These are available upon request.

V. S. Kaunismaa, P. Eng.
President

Kaval Electronics
Markham, Ontario, Canada

Jim Ford's reply:

The tests we performed were intended to illustrate the trade-offs involved in selecting a method for the RF coverage of an indoor area. The conclusion of the article was that, for many applications, radiating cable is a more cost-effective solution and one that provides better coverage than tapped lines.

We acknowledge most of the points that Mr. Kaunismaa makes, including the successful use of his equipment in several systems. In many cases, Times Alumifoam cable was used as the transmission line, along with Kaval taps and antennas. Our intent in presenting the results in the article was to help the user select the best method for achieving coverage.

Times Microwave Systems conducted the tests described in the article using equipment designed and tuned for the frequencies at which the test was run.

Jim Ford
Product Engineer
Times Microwave Systems
Wallingford, CT

Mobile Radio Technology

The journal of mobile communications technology

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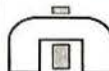
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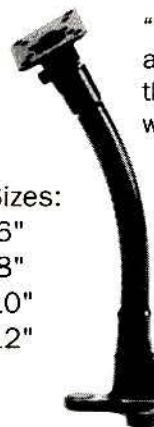
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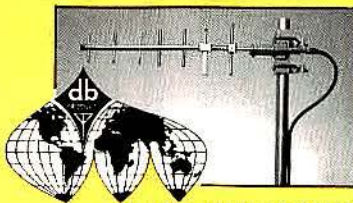
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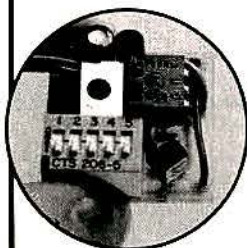
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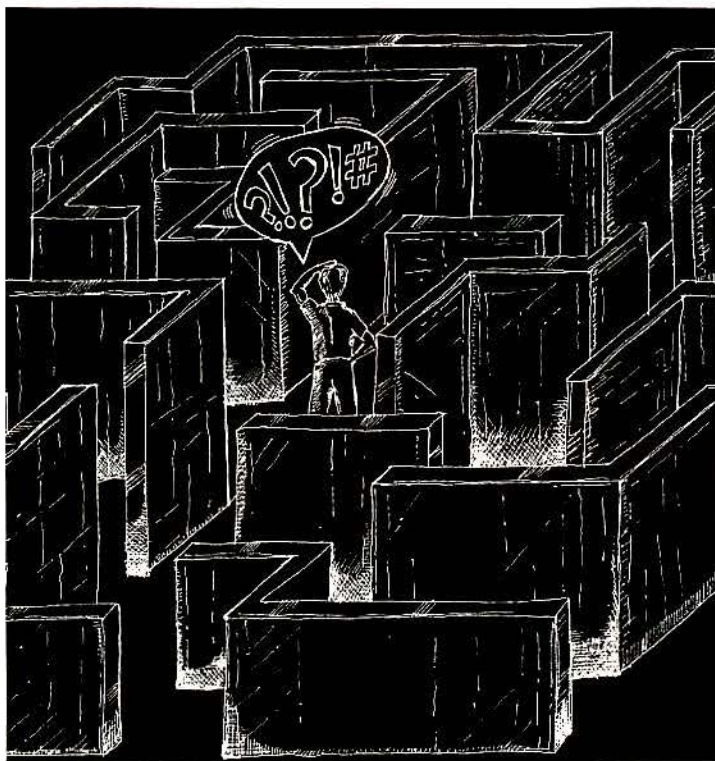
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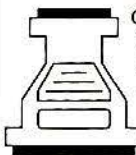
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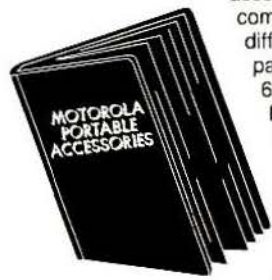
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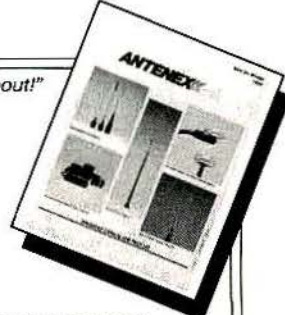
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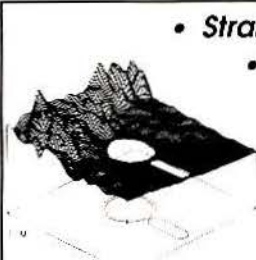
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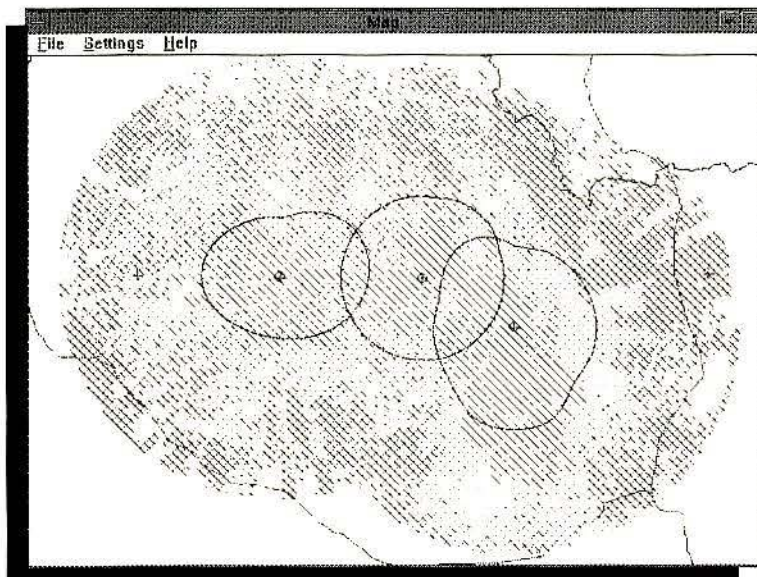
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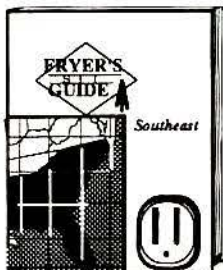
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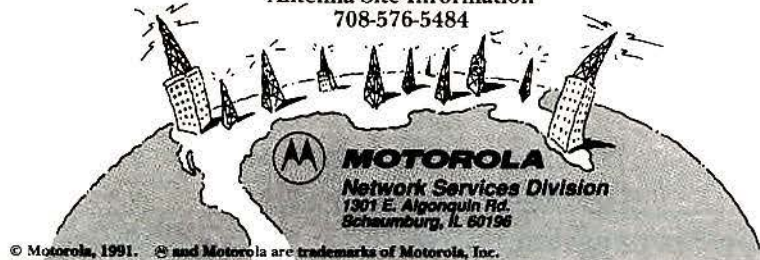
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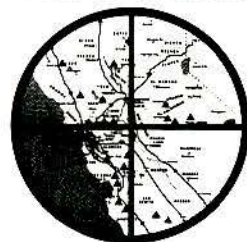
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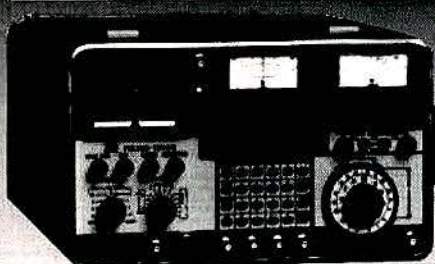
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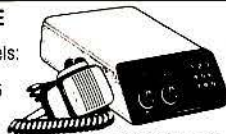
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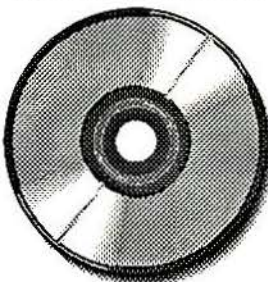
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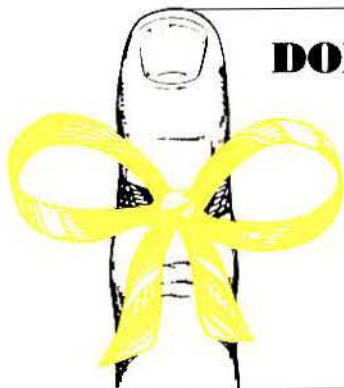
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Automation & Electronics Engr.	96	120	800-527-4596	NATCOM, Inc.	64, 79	57, 76	800-844-8287
BEE Electronics Inc.	70	63	800-345-0337	New Mar	93	108	714-751-0488
Bomar	82	81	800-526-3935	Norton Engineering	106	144	703-938-5745
Bramco Inc.	100	134	513-773-6255	Optoelectronics, Inc.	97	124	800-327-5912
California Radio	92		800-231-0103	Orbacom Systems Inc.	23	19	609-629-4455
CELWAVE	19	15	800-321-4700	Pacific Circuit Design	100	135	800-627-4432
Centurion International, Inc.	9	8	800-228-4563	Pekaar Communication, Inc.	100	132	201-772-0704
C.E.T., Inc.	68	60	904-426-0014	Percon Corporation	111	154	716-386-6015
Chargeguard Corp.	99	131	800-458-3410	Photocom, Inc.	85	90	800-223-9580
Cimarron Technologies	25	21	800-487-7184	Pipo Communications	95	118	916-644-5444
David Clark Co., Inc.	12	10	508-751-5800	Polaris Industries	98	127	800-752-3571
CML Technologies Inc.	77	73	404-266-8315	Polyphaser Corp.	14	12	800-325-7170
Combined Technologies Inc.	83	86	513-595-5900	Positron Industries, Inc.	65	58	800-443-3313
Communications Associates	99	128	800-435-9313	Pyramid Communications	95	119	414-730-4190
Communications Specialists	BC	3	800-854-0547	Quantum Publishing, Inc.	76	72	800-422-9666
Communications Data Services	107	147	800-441-0034	Radiation Systems	80	77	708-298-9420
Communication Instruments	110	153	303-962-9998	Radiocomm Assoc. of Canada	63	56	416-252-7791
Commworld Corp.	92	106	800-240-5122	Radio Express, Inc.	100	137	703-266-1928
COMTECO	62	55	800-634-4622	Radiomate	74	83	800-346-6442
Connect Systems, Inc.	13	11	800-545-1349	The Radio Shop	94	115	713-526-8000
Control Signal Corp.	20	16	303-989-8000	Radio Wholesale	101	138	800-53R-ADIO
CPI Communications, Inc.	66	59	214-437-5320	Ramsey Electronics	94	114	716-924-4560
Cushcraft/Signals Corp.	15	13	800-258-3860	RCW Distributing	98	126	800-726-9015
Daniels Electronics	60	53	604-382-8268	Ritron, Inc.	47	41	800-USA-1USA
Diablo Communications, Inc.	109	151	510-236-3700	Rocky Mountain Comms, Inc.	107		303-526-5454
D & L Communications Inc.	30, 91	25, 105	219-484-0466	Santa Fe Distributing	73	68	913-492-8288
D & L Communications Inc.	93, 96	111, 122	219-484-0466	Scala Electronic Corp.	78	75	503-779-6500
Doppler Systems, Inc.	74	79	602-488-9755	Schlumberger Technologies	21	18	800-225-5765
DX Radio Systems	55	48	213-257-0800	Selectone Corporation	3	5	800-227-0376
Dynatech Tactical Comms	84	87	603-880-4411	Sentry USA	107	148	407-773-6090
Eagle Wichita	86	91	316-265-2050	Setcom Corp.	73	67	415-965-8020
Ericsson GE Mobile Comms	49	43	800-GE1-2345	Sharp Communication	100	136	800-548-2484
E Trunk Systems, Inc.	93	110	914-245-1128	Shinwa Communications of Am.	38	32	800-627-4722
Everon America, Inc.	34-35	97	800-603-3766	Sinclair Radio Laboratories	57	50	800-288-2763
Fanon Courier	96	121	800-345-1354	Softwright	106	142	303-344-5486
Fryer's Site Guide	108	149	215-660-7804	Solar Electric Specialties	82	82	707-459-9496
Gamber Johnson	44	38	715-344-3482	Sonic Communications, Inc.	54	47	800-688-1944
GLB Electronics	86	92	716-675-6740	Sti-Co Industries, Inc.	40	34	716-662-2680
Henry Radio	80, 99	78, 129	800-877-7979	Tait Electronics USA, Inc.	42	36	713-984-8684
Hewlett Packard	45	39	509-921-4001	Tait Electronics	59	52	
Hustler, Inc.	51	45	800-949-9490	Telelink Technologies, Inc.	27	22	800-567-8884
Hutton Communications	24	20	800-442-3811	Telepoint, Inc.	75	71	310-652-3666
Hy-Q International	93	107	606-283-5000	Telewave, Inc.	88	96	415-968-4400
ICT Systems, Inc.	85	95	800-779-1917	Telex Communications, Inc.	71	64	800-752-7506
IFR Systems, Inc.	53	46	316-522-4981	Tessco	70		800-472-7373
Interactive Systems, Inc.	83	85	703-812-8270	Times Microwave Systems	81	80	203-949-8400
International Crystal Mfg.	71	65	405-236-3741	Tower Technology Corp.			813-854-1418
Intl. Public Safety Assoc.	72	66	203-847-9679	Tower Watch	110	152	800-475-1780
JBRO Batteries, Inc.	31	26	800-323-3779	TPL Communications, Inc.	76	69	213-256-3000
Kaval Electronics, Inc.	48	42	416-940-1400	Transcript International Ltd	5		800-228-0226
Kirby Enterprises	99	130	800-819-2904	Trident Micro Systems	46	40	800-798-7881
Larsen Electronics	43	37	800-426-1656	Trontech, Inc.	61	54	908-542-1133
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Leathersmith	84	88	800-233-0440	UTC Service Corp.	111	155	202-872-1268
Le BLANC	11	9	214-934-1894	Vega, A Mark IV Company	1	4	818-442-0782
Link Communications, Inc.	100	133	406-587-4085	Versatel Communications	94	113	800-456-5548
McManus Communications	93	109	501-763-6250	Vertex/Yaesu USA	IBC	2	310-404-2700
Mechem Electronics	94	116	703-373-3888	Vocom/RF Corporation	81	84	800-USA-MADE
Megahertz Technology, Inc.	98	125	214-341-1119	Wacom Products, Inc.	20	17	817-848-4435
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Meridian Comms-Comms Express	94	112	800-631-7297	West Tennessee Comm's	96	123	800-249-1250
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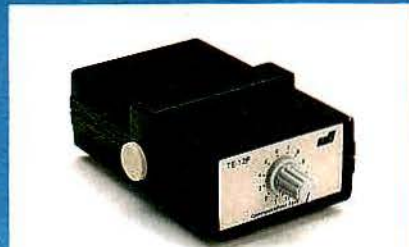
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